FORM PTO-1390 (REV02-2005) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY. DOCKET #: 5367-611PUS
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A SUBMISSION UNDER 35 U.S.C. 371	**U.S. APPLICATION NO. (If known, see 37 CFR 1.5)**

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE2009/000701	**18 May 2009**	**30 May 2008, 22 August 2008**

TITLE OF INVENTION

Electronic Device

APPLICANT(S) FOR DO/EO/US

Guenter SCHMID; Ralf KRAUSE; Stefan SEIDEL; Oliver WEISS; Christoph GAERDITZ; Ruekka SUHONEN; Ulrich NIEDERMEIER; Fryderyk KOZLOWSKI

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [x] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371
3. [x] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [x] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [] is attached hereto (required only if not communicated by the International Bureau).
   b. [x] has been transmitted by the International Bureau.
   c. [] is not required, as the application was filed in the United States Receiving Office (RO/US)
6. [x] An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. [x] is attached hereto.
   b. [] has been previously submitted under 35 U.S.C. 154(d)(4).
7. [] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [] are attached hereto (required only if not communicated by the International Bureau).
   b. [] have been transmitted by the International Bureau.
   c. [] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [] have not been made and will not be made.
8. [] An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 18. Below concern other document(s) or information included:

11. [x] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [x] A preliminary amendment.
14. [x] An Application Data Sheet under 37 CFR 1.76.
15. [] A substitute specification.
16. [] A computer-readable form of the sequence listing in accordance with PCT Rule 13*ter*.2 and 37 CFR 1.821-1.825
17. [] A change of power of attorney and/or address letter.
18. [x] Other items or information: *(specify):* PCT/IB/304, PCT/IB/308 (Second & Supp. Notice), Int'l Search Report, Written Opinion, Cover page of published PCT application; Request for Publication of Assignment Information

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U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5)	INTERNATIONAL APPLICATION NO. PCT/DE2009/000701	ATTORNEY'S DOCKET NUMBER 5367-611PUS

The following fees are submitted: 21. **[x] Basic National Fee (37 CFR 1.492(a)(1)-(5))** **$330**	$	330
[x] **Examination Fee** If International preliminary examination report is prepared by USPTO and all claims satisfy the provisions of PCT article 33(1)-(4) **$0** All other situations **$220**	$	**220**
22. **[x] Search Fee** Search fee (37 CFR 1.445(a)(2)) has been paid on the International application to the USPTO as an International Searching Authority **$100** International Search Report prepared and provided to the Office **$430** All other situations **$540**	$	430
ENTER APPROPRIATE BASIC FEE AMOUNT (total of 21, 22 and 23) =	$	
[] Application Fee for specification and drawing filed in paper over 100 sheets (excluding sequence listing or computer program listing filed in electronic medium). The fee is for each additional 50 sheets of paper or fraction thereof.		

Total Sheets	Extra Sheets	Number of additional 50 or fraction thereof (round up to a whole number)	RATE		
-100 =	/50 =		x **$270**	$	
Surcharge of **$130.00** for furnishing the oath or declaration later than 30 months from the earliest claimed priority date (37 CFR 1.492(h)).				$	980

Claims	Number Filed	Number Extra	RATE		
Total Claims	15 - 20 =	0	x **$ 52.00**	$	
Independent Claims	1 - 3 =	0	x **$220.00**	$	
Multiple dependent claim(s) (if applicable)			+ **$390.00**	$	
TOTAL OF ABOVE CALCULATIONS =				$	980
[] Applicant claims small entity status. See 37 CFR 1.27. Fees above are reduced by ½.				$	
SUBTOTAL =				$	980
Processing fee of **$130.00** for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(i)). +				$	
TOTAL NATIONAL FEE =				$	980
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by the appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
TOTAL FEES ENCLOSED					$
Amount to be refunded:					$
Amount to be charged:					**$980**

a. [x] Please charge my Deposit Account No. 03-2412 in the amount of $980.00 to cover the above fees. .

b. [x] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 03-2412.

NOTE: Where an appropriate time limit under 37 CFR 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re National Phase PCT Application of
Guenter SCHMID et al.
Int'l PCT Serial No.: PCT/DE2009/000701
Int'l Filing Date:: 18 May 2009
For: Electronic Device

Commissioner for Patents
P.O. Box 1450
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REQUEST FOR PUBLICATION OF ASSIGNMENT INFORMATION

S I R:

It is requested that the following assignment information be published as part of the 18 month publication of the present application:

OSRAM Opto Semiconductors GmbH
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Respectfully submitted,
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Dated: 30 November 2010

SDC EX. 1002 - 3/325

Application Information

Application number::	
Filing Date::	
Application Type::	***Regular***
Subject Matter::	***Utility***
CD-ROM or CD-R?::	***None***
Title ::	Electronic Device
Attorney Docket Number::	5367-611PUS
Request for Early Publication?::	***No***
Request for Non-Publication?::	***No***
Total Drawing Sheets::	5
Small Entity?::	***No***

SDC EX. 1002 - 4/325

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Representative Information

Representative Customer Number::	27799

Domestic Priority Information

Application ::	**Continuity Type::**	**Parent Application::** *no more than 20 characters*	**Parent Filing Date::** *8 characters, MM / DD / YY*
		PCT/DE2009/000701	18 May 2009

Foreign Priority Information

Country::	**Application number::**	**Filing Date::**	**Priority Claimed::**
Germany	10 2008 025 920.9	30 May 2008	[x] YES
Germany	10 2008 039 361.4	22 August 2008	[x] YES
			[] YES
			[] YES
			[] YES

SDC EX. 1002 - 9/325

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Attorney Docket # 5367-611PUS

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re National Phase PCT Application of
Guenter SCHMID et al.
International Appln. No.: PCT/DE2009/000701
International Filing Date: 18 May 2009
For: Electronic Device

PRELIMINARY AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

S I R:

Prior to examination of the above-identified application please amend the application as follows:

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Claims are reflected in the listing of claims which begins on page 4 of this paper.

Amendments to the Abstract begin on page 7 of this paper.

Remarks/Arguments begin on page 8 of this paper.

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In the Specification:

On page 1, after the title, insert the following:

RELATED APPLICATIONS

This is a U.S. national stage of application No. PCT/DE2009/000701, filed on May 18, 2009.

This patent application claims the priorities of German Patent Application 10 2008 025 920.9 filed May 30, 2008 and German Patent Application 10 2008 039 361.4 filed August 22, 2008, the disclosure content of both of which is hereby incorporated by reference.

FIELD OF THE INVENTION

On page 1, delete the paragraph beginning at line 7 in its entirety.

On page 1, before line 12, insert the following heading:

BACKGROUND OF THE INVENTION

On page 1, before line 24, insert the following heading:

SUMMARY OF THE INVENTION

On page 1, amend the paragraph beginning at line 24 through page 2, line 2 as follows:

~~The goal~~ One object of the invention is to provide an electronic device with an improved charge carrier transport and an improved charge carrier balance in the organic layers and thus an increased efficiency. Another ~~goal~~ object of the invention is to provide a method for the production of an electronic device. ~~These goals are attained by an electronic device in~~

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~~accordance with Claim 1, and a method for the production of the electronic device in accordance with Claim 12. Other embodiments of the device and of the method are the object of other claims.~~

On page 11, delete the paragraph beginning at line 29 in its entirety.

On page 11, before line 32, insert the following heading:

BRIEF DESCRIPTION OF THE DRAWINGS

On page 12, before line 9, insert the following heading:

DETAILED DESCRIPTION OF THE DRAWINGS

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Listing of Claims:

1. (Currently amended) ~~Electronic~~ An electronic device, comprising:

[[-]] a substrate[[,]];

[[-]] a first electrode[[,]];

[[-]] at least one organic functional layer[[,]]; and

[[-]] a second electrode, wherein the at least one organic functional layer is located between the first electrode and the second electrode, and wherein the at least one organic functional layer has at least a first matrix material, a second matrix material, and a third matrix material, and the third matrix material has a Lowest Unoccupied Molecular Orbital (LUMO), which is energetically lower than the LUMO of the second matrix material and the LUMO of the first matrix material, and wherein the second matrix material has a Highest Occupied Molecular Orbital (HOMO), which is energetically higher than the HOMO of the first matrix material and the HOMO of the third matrix material.

2. (Currently amended) ~~Electronic~~ The electronic device according to ~~the preceding~~ claim 1, wherein the first matrix material has a LUMO which is energetically higher than the LUMO of the second matrix material and the LUMO of the third matrix material, and a HOMO which is energetically lower than the HOMO of the second matrix material and the HOMO of the third matrix material.

3. (Currently amended) ~~Electronic~~ The electronic device according to ~~the preceding claims~~ claim 1, wherein the second matrix material has a LUMO which is energetically higher than the LUMO of the third matrix material, and a HOMO which is energetically higher than the HOMO of the third matrix material.

4. (Currently amended) ~~Electronic~~ The electronic device according to ~~one of the preceding claims~~ claim 1, wherein the first matrix material has a charge carrier mobility which is lower than the charge carrier mobilities of the second and third matrix materials.

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5. (Currently amended) ~~Electronic~~ The electronic device according to ~~one of the preceding claims~~ claim 1, wherein the second matrix material comprises a hole transport material.

6. (Currently amended) ~~Electronic~~ The electronic device according to ~~one of the preceding claims~~ claim 1 wherein the third matrix material comprises an electron transport material.

7. (Currently amended) ~~Electronic~~ The electronic device according to ~~one of the preceding claims~~ claim 1, wherein the organic functional layer is selected from a group which comprises emission layers, electron transport layers, hole transport layers, electron blocking layers, hole blocking layers, hole injection layers, electron injection layers, and intermediate layers.

8. (Currently amended) ~~Electronic~~ The electronic device according to ~~one of the preceding claims~~ claim 1, wherein the organic functional layer is an emission layer and is doped with at least one emitter material.

9. (Currently amended) ~~Electronic~~ The electronic device according to ~~the preceding~~ claim 1, wherein the emitter material in the emission layer has a concentration of 10 wt%.

10. (Currently amended) ~~Electronic~~ The electronic device according to ~~the preceding~~ claim 1, wherein the concentration of the emitter material in the emission layer has a gradient.

11. (Currently amended) ~~Electronic~~ The electronic device according to ~~one of Claims 8 to 10~~ claim 8, wherein the LUMO of the emitter material is energetically lower than the LUMO of the first, second, and third matrix materials, and the HOMO of the emitter material is energetically higher than the HOMO of the first, second, and third matrix materials.

12. (Currently amended) ~~Electronic~~ The electronic device according to ~~one of the preceding claims~~ claim 1, which is constructed as a radiation-emitting device.

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13. (Currently amended) ~~Electronic~~ The electronic device according to ~~one of Claims 1 to 11~~ claim 1, wherein the device is selected from a group which comprises an organic light-emitting device, a solar cell, and a transistor.

14. (Currently amended) ~~Method~~ A method for the production of an electronic device according to ~~Claims 1 to 13, with the method~~ steps claim 1, comprising the steps of:

A) preparation of a substrate[[,]];

B) preparation of a first electrode and a second electrode[[,]]; and

C) placement of at least one organic functional layer between the first electrode and the second electrode,

wherein in method step C), at least the first matrix material, the second matrix material, and the third matrix material are simultaneously applied.

15. (Currently amended) ~~Method~~ A method according to ~~the preceding~~ claim 1, wherein in the method step C), the first matrix material, the second matrix material, and the third matrix material are applied by evaporation coating.

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Amendments to the Abstract

Abstract of the Disclosure

~~Electronic device~~

An electronic device comprising a substrate, a first electrode, at least one organic functional layer, and a second electrode is indicated. The organic functional layer comprises a first, a second, and a third matrix material, wherein the first matrix material has a larger band gap than the second and the third matrix materials.

~~Significant Figure 1~~

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REMARKS

This preliminary amendment is presented to place the application in better form for examination and to eliminate multiple dependency from the present claims. No new matter has been added. Early examination and favorable consideration of the above-identified application is earnestly solicited.

Any additional fees or charges required at this time in connection with the application may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
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30 November 2010

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Description

Electronic device

The invention concerns an electronic device and a method for the production of an electronic device.

This patent application claims the priorities of German Patent Application 10 2008 025 920.9 and German Patent Application 10 2008 039 361.4, whose disclosure content is hereby taken up by reference.

Electronic devices, such as organic light-emitting diodes (OLEDs), consist of a sequence of several functional organic layers. Emission layers thereby have a matrix material, which is doped with emitter molecules. In the emission layer, excitons are formed by a recombination of electrons and "holes," which lead to light emission. In order to obtain a high efficiency of the electronic device, the ratio between electrons and "holes" which are transported in the emission layer is decisive. A nonbalanced ratio between hole and electron transport results in a low radiation efficiency of the device.

The goal of the invention is to provide an electronic device with an improved charge carrier transport and an improved charge carrier balance in the organic layers and thus an increased efficiency. Another goal of the invention is to provide a method for the production of an electronic device. These goals are attained by an electronic device in accordance with Claim 1, and a method for the production of the electronic device in accordance with Claim 12. Other embodi-

ments of the device and of the method are the object of other claims.

In accordance with an embodiment, an electronic device is provided which comprises a substrate, a first electrode, at least one organic functional layer, and a second electrode, wherein the at least one organic functional layer is disposed between the first electrode and the second electrode. For example, the first electrode can be located on the substrate; the at least one organic functional layer, on the first electrode; and the second electrode, on the at least one organic functional layer. The at least one organic functional layer has at least a first matrix material, a second matrix material, and a third matrix material, wherein the third matrix material has a Lowest Unoccupied Molecular Orbital (LUMO), which is energetically lower than the LUMO of the second matrix material and the LUMO of the first matrix material, and wherein the second matrix material has a Highest Occupied Molecular Orbital (HOMO), which is energetically higher than the HOMO of the first matrix material and the HOMO of the third matrix material. Thus, an electronic device is made available which comprises more than two different matrix materials in an organic functional layer. Three different matrix materials can be present thereby, and depending on the need, more than three also.

According to the molecular orbital theory, in one molecule there are several molecular orbitals with different energy levels, which can be occupied by the existing electrons. These molecular orbitals are occupied according to increasing energy level. The LUMO is the energetically lowest molecular orbital which is no longer occupied with an electron. The

HOMO is the energetically highest molecular orbital which is still occupied with an electron.

This electronic device has an improved charge carrier transport and an improved charge carrier balance in the organic functional layer, and an adaptable ratio between the hole and electron transport. The first matrix material is selected thereby so that it has a large band gap that is, the difference between HOMO and LUMO, for example, so that its HOMO is energetically below the HOMO of the other two matrix materials, and its LUMO is energetically above the LUMO of the other two matrix materials.

Furthermore, the first matrix material can have a LUMO which is energetically higher than the LUMO of the second matrix material and the LUMO of the third matrix material, and a HOMO which is energetically lower than the HOMO of the second matrix material and the HOMO of the third matrix material.

Furthermore, the second matrix material in the electronic device can have a LUMO which is energetically higher than the LUMO of the third matrix material, and a HOMO which is energetically higher than the HOMO of the third matrix material. Thus, the first matrix material can have the largest band gap between the HOMO and the LUMO, in comparison to the second and the third matrix material, and the second matrix material has a band gap which is shifted energetically to the band gap of the third matrix material. In this way, electrons can be transported on the LUMO of the third matrix material, and holes can be transported on the HOMO of the second matrix material, since these energy levels are in each case the energetically most favorable for the individual charge transport.

The first matrix material can have a charge carrier mobility in the electronic device which is less than the charge carrier mobility of the second and the third matrix material. The first matrix material can be an Ultra Wide Band Gap (UGH) material, which has a band gap that is large in comparison to the other matrix materials. Thus, it cannot have a share in the charge carrier transport.

The second matrix material can also comprise a hole transport material, and the third matrix material can comprise an electron transport material.

The charge carrier transport – that is, the hole transport and the electron transport – depends, in particular, on the mobility of the holes or of the electrons in a material and on the position of the energy level HOMO and LUMO of the matrix materials. The HOMO and LUMO of a material are thereby responsible for the charge carrier injection.

To create a hole in the matrix, which is composed of the three matrix materials, an electron must be removed from the HOMO, for example, which is more difficult with an energetically low HOMO than with an energetically higher one. Thus, the second matrix material, which has a higher HOMO than the third matrix material, is more suitable as the hole transport material than the third matrix material. Something analogous is true for the creation of electrons in LUMOs, which is energetically favored with energetically lower LUMOs. Thus, the third matrix material, which has a lower LUMO than the second matrix material, is suitable as the electron transport material.

If holes and electrons are created, the mobility of these charge carriers in the material plays a role. Depending on how these two factors interact in a material, it is possible for a matrix material to be used as an electron transport material or as a hole transport material. The charge carrier transport of the other charge also takes place thereby, but the transport of one charge carrier is predominant. If a charge carrier transport does not take place in a matrix material, as in an embodiment of the invention in the first matrix material, then that can be attributed to the fact that charge carriers are not created or that there is no mobility of the charge carrier. In addition to the first matrix material, other matrix materials can be present in the organic functional layer which do not contribute to the charge carrier transport.

The HOMO and LUMO energy levels of a material can be measured so as to select suitable materials for a first, second, and third matrix material. Thus, the HOMO of a material can be determined by means of cyclovoltametry. The band gap—that is, the energetic difference between HOMO and LUMO—can also be determined by means of spectroscopy, in which the wavelength of the emitted light is measured, and therefrom the generated excitons and the band gap are calculated. The energy level of the LUMO is then calculated from the determined HOMO and the band gap. The HOMO can alternatively also be determined by means of photoelectron spectroscopy.

The mobility of electrons and holes can depend on the molecule distance—that is, the average distance between charge carrier-transporting molecules in the individual matrix material. Thus, the concentration of a matrix material in the mixture of several matrix materials plays a role. The first

matrix material, which in comparison to the second and third matrix material has the largest band gap and the smallest charge carrier mobility, can be used to adjust the concentration of the second and the third matrix material separately from one another. Depending on the selected concentration of the second and third matrix material, the distances between the individual molecules change. The microscopic charge carrier transport depends on the molecule distance between the charge carrier-transporting molecules in the individual matrix material, so that by the adjustment of the concentration, the mobility of electrons and holes in the matrix, which has at least three matrix materials, can be absolutely adjusted separately from one another.

According to Miller and Abraham, the mobility can be determined in the following manner:

$$\nu_{ij} = \nu_0 \exp[-2\gamma a(\Delta R_{ij}/a)]$$

In this model, a solid state body is built up, schematically seen from places i and j, on which are the charge carriers. Each place represents a localized state. The transport of a charge carrier between places i and j is represented by a resistance Rij. The magnitude of the temperature-dependent resistance reflects thereby the spatial distance between the places and the needed activation energy for the transition. The parameter γ stands for the decline of the electronic wave function of the charge carrier; a is the parameter for the average lattice distance. The phonon frequency v0 gives the number of the attempts of a charge carrier to get from one localized state to another localized state; it lies in the range of approximately 1013 s-1, and it takes into consideration the strength of the electron phonon coupling.

The electronic device can also have an organic functional layer, which is selected from a group that comprises emission layers, electron transport layers, hole transport layers, electron blocking layers, hole blocking layers, hole injection layers, electron injection layers, and intermediate layers. Intermediate layers is the name given to layers that are located between two emission layers. Depending on the kind of organic functional layer selected, these layers can also contain additional doping substances. The organic functional layer can be an emission layer and be doped with at least one emitter material.

Emitter materials can comprise small molecules or polymers. The concentration of the emitter material in an emission layer can be up to 10 wt%. Furthermore, the emitter material may have only a low charge carrier mobility as a result of the low concentration in the emission layer, and thus contribute only slightly to the charge carrier transport.

In the emission layer, it is also possible for two or three emitter materials to be present. The emitter materials can be selected, for example, from the green-emitting Ir(ppy)3 (tris(2-phenylpyridine)iridium(III), the red-emitting Ir(piq)3 (tris(1-phenylisoquinoline)iridium(III)), or the blue-emitting firpic (bis(3,5-difluoro-2-(2-pyridyl)phenyl-(2-carboxypyridyl)iridium(III)).

The concentrations of the emitter material and the matrix materials in the organic functional layer can have a gradient within the organic functional layer. Thus, for example, the concentration of the emitter material can be higher in a

first partial area of the layer than in a second partial layer.

By not doping with emitter materials, it is possible to produce transport, intermediate, and blocking layers.

It is also possible for several organic functional layers to be present in an electronic device, wherein the layers can have different functions or the same functions. For example, an electronic device can have a sequence of several functional, organic layers, which, for example, is composed of a hole injection layer, a hole transport layer, a first emission layer, an intermediate layer, a second emission layer, an electron transport layer, and an electron injection layer. Each of these layers can have a matrix, which has at least a first, a second, and a third matrix material. The matrix materials in the various organic functional layers can be selected similarly or differently in all layers.

Depending on where the emission layer is located in the layer stack of the electron device, it is possible to optimize the mobility of electrons and holes within this layer separately from one another if the emission layer has a first, a second, and a third matrix material. The mobility can also be optimized over several layers.

Even if the emission layer which has the three matrix materials is close to an anode or a cathode, the mobility of electrons and holes can be adjusted in such a way that the ratio of holes and electrons is balanced in the emission layer. Depending on which charge carrier type is to have a higher mobility, the matrix can contain a higher concentration of the individual matrix material. Thus, a high number of excitons

can be formed in the emission layer, independent of the position of the emission layer of the electronic device.

If the organic functional layer is an emission layer with an emitter material, the LUMO of the emitter material can be energetically lower than the LUMO of the first, second, and third matrix material, and the HOMO of the emitter material can be energetically higher than the HOMO of the first, second, and third matrix material. Thus, the band gap between the HOMO and LUMO of the emitter material is smaller than the band gaps of the three matrix materials and, moreover, energetically is between all band gaps of all matrix materials. An ambipolar charge transport in an emission layer is thus possible.

The molecules of the second and third matrix materials preferably transport only one charge carrier type, holes or electrons; thus, no excitons are formed on them. In this way, the service life of the materials is increased, since degradation due to excitation energy cannot take place. Between the various molecules of the matrix materials, excited states (excimers) are formed which can transfer their excitation energy by energy transfer to the emitter molecules. Thus, the efficiency of the electronic device is further increased.

An electronic device can also have several emission layers, for example, in order to combine phosphorescent and fluorescent emitter materials in one device. Then, the insertion of an intermediate layer, which may have, for example, ambipolar charge transport characteristics, may be necessary. This is possible by the combination of three matrix materials.

By the adjustment of the charge carrier mobility with the aid of the three matrix materials, it is possible to purposefully influence the position of the recombination zone in an emission layer. The recombination zone can be thereby distributed within one layer or over several layers. By the introduction of the first matrix, which does not have a charge transport, within an emission layer, the absolute value of the charge carrier mobility decreases. A recombination zone, the zone in which excitons are formed, is produced therefrom, which is shifted from the borders of an emitting layer to the middle. This increases the efficiency of the device, since among other things, the nonradiating quenching of excitons is reduced and more excitons are formed in the actual emission layer instead of in the adjacent layers.

The electronic device can be a radiation-emitting device, for example, an organic light-emitting device. This light-emitting device can be an organic light-emitting diode (OLED). Furthermore, the electronic device can comprise a solar cell or a transistor.

For example, the at least one organic functional layer is located in a transistor between the first and the second electrodes. Furthermore, a third electrode is present. The electrodes can be selected from gate, source, and drain electrodes. A transistor can be used to switch or reinforce electric signals.

In a solar cell, light can be converted into electric energy. Here, the organic functional layer is situated between the first and the second electrodes, wherein at least one of the electrodes is formed transparent.

The device can have, for example, mCP (m-bis(N-carbazolylbenzene)), as the first matrix material in an organic functional layer; as a second matrix material, which can be a hole transport material, TCTA (9H-carbazole, 9, 9', 9"-(1,3,5-benzenetriyl)tris-(9Cl)); and as a third matrix material, which can be an electron transport material, for example, TPBi (1,3,5-tris(N-phenylbenzylimidazol-2-yl). If a matrix is to be prepared for an emission layer, the yellow emitter rubrene (5,6,11,12-tetraphenylnaphthacene) can be inserted as the emitter material, for example.

Furthermore, a method for the production of an electronic device with the characteristics described above is prepared. The method comprises the method steps A) preparation of a substrate, B) preparation of a first electrode and a second electrode, C) placement of at least one organic layer between the first electrode and the second electrode. For example, the at least one organic functional layer can be disposed on the first electrode, and the second electrode can be disposed on the organic functional layer. In method step C), at least a first matrix material, a second matrix material, and a third matrix material are simultaneously applied. The application in method step C) can take place, for example, by evaporation coating (coevaporation). By the simultaneous application, the concentration of the individual matrix material can be determined independently of the other matrix materials, so that the matrix materials can be applied in different concentrations.
With the aid of the figures and embodiment examples, the invention will be explained in more detail:

Figure 1 shows the schematic side view of an electronic device,

Figure 2 shows a schematic view of the energetic states of the various matrix materials,
Figure 3 shows a schematic side view of an electronic device,
Figure 4 shows the simulation of the mobility of the charge carrier in an emission layer,
Figure 5 shows the schematic structure of the production of a layer with several matrix materials.

Figure 1 shows the schematic side view of an electronic device comprising a substrate 10, a first electrode 20, an emission layer 30, and a second electrode 40. The first electrode can, for example, be an anode and the second electrode, a cathode. Depending on whether the substrate and the first electrode or the second electrode are formed transparent, the electronic device may be a bottom-emitting or a top-emitting device, for example, an OLED. The emission layer 30 can have a first, a second, and a third matrix material and be doped with an emitter material.

Figure 2 shows the schematic representation of the energy level of the individual materials in the emission layer in an embodiment shown by way of example. The HOMO and the LUMO of the first matrix material 30N, the second matrix material 30B, and the third matrix material 30A are shown. The first matrix material has a HOMO which is energetically lower than the HOMO of the second matrix material and the third matrix material. Furthermore, the first matrix material has a LUMO which is energetically higher than the LUMO of the second matrix material and the third matrix material. The second matrix material has a LUMO which is energetically higher than the LUMO of the third matrix material, and a HOMO which is energetically higher than the HOMO of the third matrix material. Thus, the first matrix material has lower charge car-

rier mobilities than the other two matrix materials; the second matrix material can comprise a hole transport material, and the third matrix material an electron transport material. The emitter material 30E has a HOMO and LUMO which has the smallest band gap in comparison to the matrix materials, and is between the LUMOs and the HOMOs of the three matrix materials.

To the right in the scheme, the sum of the different energy levels is shown. A symbolizes the energy level at which the electron transport takes place; B symbolizes the energy level at which the hole transport takes place. d1 and d2 represent the energetic distances between the LUMOs of the first and second matrix materials (d1) and the HOMOs of the first and third matrix materials (d2). d3 symbolizes the band gap of the emitter material. If no emitter material is used, the layer may also be a charge carrier transport, charge carrier injection, or charge carrier blocking layer. Furthermore, several emitter materials can also be used. The emitter material has a concentration of $\leq$ 10 wt% in the emission layer.

Figure 3 shows the schematic side view of another embodiment of the electronic device which has an emission layer 30 on one side on which border an electron transport layer 32 and a hole transport layer 31. The first electrode 20 is an anode. Both the emission layer 30 and also the electron transport layer 32 and the hole transport layer 31 can have matrices which are composed of three or more matrix materials.

Figure 4 shows the simulation of the charge carrier transport in an OLED, in which an emission layer, a hole transport layer 31, and an electron transport layer 32 are present. The x axis shows the distance of the individual layer from the

anode D [nm]; the y axis shows the standardized recombination rate Rn. One can see that with a reduction of the absolute value of the charge carrier mobility in the emission layer 30, in comparison to the hole transport layer 31 and the electron transport layer 32, the recombination zone is shifted from the borders of the emission layer to the middle. This means that with a declining mobility of the charge carrier in the emission layer 30, the recombination in the adjacent layer 32 and 31 is reduced and is shifted to the middle of the emission layer 30.
In the simulation, the electron and hole mobilities in the emission layer were equated—that is—an ambipolar charge transport is assumed. An ohmic injection was assumed; all energy barriers between HOMO and LUMO of the two layers were 400 meV for the individual charge carrier types. In the diagram, the individual mobilities of the charge carriers are indicated in m2/Vs for the various line forms; they fluctuate between 10-8 to 10-12.

Figure 5 shows the schematic side view of a structure for the production of the electronic device. Four evaporation sources 50 are applied on a holder 51, for example, from which matrix materials and/or doping substances can be evaporated onto the deposition substrate 60. In order to be able to determine the individual concentration of the matrix material and/or the doping substances precisely, the evaporation rate is measured and adjusted via layer thickness monitors 55. The layer thickness monitors can be, for example, oscillator quartzes.

For example, with a structure according to Figure 5, one can produce an emission layer which contains a first matrix material, which comprises mCP (m-bis(N-carbazolylbenzene)) and is applied at an evaporation rate of 3.8 Å/s. The second matrix

material, the hole transport material, can be TCTA (9H-carbazole,9,9',9"-(1,3,5-benzenetriyl)tris-(9C1)) and can be applied at an evaporation rate of 8 Å/s. The third matrix material, the electron transport material, can be, for example, TPBi (1,3,5-tris(N-phenylbenzylimidazol-2-yl) and can be applied at an evaporation rate of 8 Å/s. The yellow emitter rubrene (5,6,11,12-tetraphenylnaphthacene) can be introduced, for example, as the emitter material and can be applied at an evaporation rate of 0.2 Å/s. In this way, a layer with a volume concentration of 40% is produced for the charge carrier transport materials and 1%, for the emitter. The HOMOs and LUMOs of these materials are given in Table 1. The values of the HOMOs of TCTA, TPBi, mCP were determined by UV photoemission spectroscopy; the corresponding LUMO values were estimated in that the energy required for the absorption was added to the HOMO value. The HOMO and LUMO values of rubrene were determined by means of cyclovoltammetry and photoelectron spectrometry.

Table 1

	HOMO [eV]	LUMO [eV]
mCP	-5,9	-2,4
TCTA	-5,7	-2,3
TPBi	-6,3	-2,8
Rubren	-5,5	-3,0

Key: 1 Rubrene

The third matrix material TPBi has the lowest LUMO value in comparison with the other matrix materials, and is thus the electron transport material. The second matrix material TCTA has the largest HOMO value, in comparison with the other ma-

trix materials, and is thus the hole transport material. The first matrix material mCP does not participate in the charge carrier transport, since its LUMO is not lower than the LUMO of the third matrix material and its HOMO is not higher than the HOMO of the second matrix material.

Other possible hole transport materials are the following:

NPB N,N'-bis(naphthalen-1-yl)-N,N'-bis(phenyl)benzidine

TCTA 4,4',4"-tris(carbazol-9-yl)triphenylamine

CPB 4,4'-bis(carbazol-9-yl)biphenyl

1T-NATA 4,4',4"-tris(N-(1-naphthyl)-N-phenylamino)triphenylamine

Spiro-TAD 2,2',7,7'-tetrakis(N,N-diphenylamino)-9,9'-spirobifluorene

As electron transport materials, the following can also be used:

TPBi 2,2',2"-(1,3,5-benzenetriyl)tris(1-phenyl-1-H-benzimidazole)

TAZ 3-(4-biphenyl)-4-phenyl-5-tert-butylphenyl-1,2,4-triazole

Alq3 tris(8-hydroxyquinolinato)aluminum

BCP 2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline

NTAZ 4-(naphthalen-1-yl)-3,5-diphenyl-4H-1,2,4-triazole

Balq bis(2-methyl-8-quinolinolate)-4-(phenylphenolato)aluminum

As the first matrix material that has the lowest charge carrier mobility in comparison to the other matrix materials, one can use the following:

UGH-2 1,4-bis(triphenylsilyl)benzene

UGH-3 1,3-bis(triphenylsilyl)benzene

mCP 1,3-bis(carbazol-9-yl)benzene

The HOMOs of UGH-2 and UGH-3 have values of -7.2 ± 0.1 eV; the LUMOs are 2.8 eV. These HOMO values can be determined by means of photoelectron spectroscopy; the LUMO values can be estimated from the distance from HOMO values and LUMO values at the intersection of the absorption and the fluorescence spectrum.

Possible emitter materials are the following

Ir(ppy)3 tris(2-phenylpyridine)iridium(III)

Ir(ppy)2 bis(2-phenylpyridine)(acetylacetonate)iridium(II) (acac)

BczVBi 4,4'-bis(9-ethyl-3-carbazovinylene)-1,1'-biphenyl

FirPic bis(3,5-difluoro-2-(2-pyridyl)phenyl-(2-carboxypyridyl)iridium(III)

Rubrene tetraphenyl naphthacene

Ir(piq)3 tris(1-phenylisoquinoline)iridium(III)

These emitter materials are small nonpolymer molecules. The use of polymeric emitter materials is likewise possible.

Other possible materials, which, depending on the position of their HOMOs and LUMOs with respect to one another, can be used as the first, second, or third matrix, are the following:

Bphen 4,7-diphenyl-1,10-phenanthroline

DPAVBi 4,4'-bis(2-(4-(N,N-diphenylamino)phenyl)vinyl) biphenyl

CuPC Phthalocyanine copper complex

S-DPVBi 2,2',7,7'-tetrakis(2,2-diphenylvinyl)spiro-9,9'-bifluorene CPF

TAPC 1,1-bis(4-bis(4-methylphenyl)aminophenyl) cyclohexane

TBADN 9,10-bis(2-naphthyl)-2-t-butylanthracene

TPD N,N,N',N'-tetraphenyl benzidine

Some of the electron and hole transport materials can also be used as the first matrix material. The relative ratio of the LUMOs and HOMOs of the three combined materials and their position to one another is important in the compilation of the first, second, and third matrix material for the matrix.

The matrix cannot be selected arbitrarily for phosphorescent emitters because of chemical compatibility. The red emitter iridium (III) bis(2-methyldibenzo[f,h]quinoxaline)acetylacetonate) is only efficient in an NBP matrix. NPB, however, is a hole transport material. If on the anode side, there is also another emitter layer, then this is not sufficiently supplied with electrons. By doping in an electron transport material, for example, BCP, the relative transport characteristics can be adjusted. The fine coordination of the transport characteristics takes place with UGH4.

The embodiments shown in the figures and embodiment examples can be arbitrarily varied. It should also be taken into consideration that the invention is not limited to the examples, but rather permits other developments not listed here.

Claims

1. Electronic device, comprising

-a substrate,

-a first electrode,

-at least one organic functional layer, and

-a second electrode, wherein the at least one organic functional layer is located between the first electrode and the second electrode, and wherein the at least one organic functional layer

has at least a first matrix material, a second matrix material, and a third matrix material, and the third matrix material has a Lowest Unoccupied Molecular Orbital (LUMO), which is energetically lower than the LUMO of the second matrix material and the LUMO of the first matrix material, and wherein the second matrix material has a Highest Occupied Molecular Orbital (HOMO), which is energetically higher than the HOMO of the first matrix material and the HOMO of the third matrix material.

2. Electronic device according to the preceding claim, wherein the first matrix material has a LUMO which is energetically higher than the LUMO of the second matrix material and the LUMO of the third matrix material, and a HOMO which is energetically lower than the HOMO of the second matrix material and the HOMO of the third matrix material.

3. Electronic device according to the preceding claims, wherein the second matrix material has a LUMO which is energetically higher than the LUMO of the third matrix material, and a HOMO which is energetically higher than the HOMO of the third matrix material.

4. Electronic device according to one of the preceding claims, wherein the first matrix material has a charge carrier mobility which is lower than the charge carrier mobilities of the second and third matrix materials.

5. Electronic device according to one of the preceding claims, wherein the second matrix material comprises a hole transport material.

6. Electronic device according to one of the preceding claims, wherein the third matrix material comprises an electron transport material.

7. Electronic device according to one of the preceding claims, wherein the organic functional layer is selected from a group which comprises emission layers, electron transport layers, hole transport layers, electron blocking layers, hole blocking layers, hole injection layers, electron injection layers, and intermediate layers.

8. Electron device according to one of the preceding claims, wherein the organic functional layer is an emission layer and is doped with at least one emitter material.

9. Electronic device according to the preceding claim, wherein the emitter material in the emission layer has a concentration of $\leq$ 10 wt%.

10. Electronic device according to the preceding claim, wherein the concentration of the emitter material in the emission layer has a gradient.

11. Electronic device according to one of Claims 8 to 10, wherein the LUMO of the emitter material is energetically lower than the LUMO of the first, second, and third matrix materials, and the HOMO of the emitter material is energetically higher than the HOMO of the first, second, and third matrix materials.

12. Electronic device according to one of the preceding claims, which is constructed as a radiation-emitting device.

13. Electronic device according to one of Claims 1 to 11, wherein the device is selected from a group which comprises an organic light-emitting device, a solar cell, and a transistor.

14. Method for the production of an electronic device according to Claims 1 to 13, with the method steps

A) preparation of a substrate,

B) preparation of a first electrode and a second electrode,

C) placement of at least one organic functional layer between the first electrode and the second electrode,

wherein in method step C), at least the first matrix material, the second matrix material, and the third matrix material are simultaneously applied.

15. Method according to the preceding claim, wherein in the method step C), the first matrix material, the second matrix material, and the third matrix material are applied by evaporation coating.

Abstract

Electronic device

An electronic device comprising a substrate, a first electrode, at least one organic functional layer, and a second electrode is indicated. The organic functional layer comprises a first, a second, and a third matrix material, wherein the first matrix material has a larger band gap than the second and the third matrix materials.

Significant Figure 1

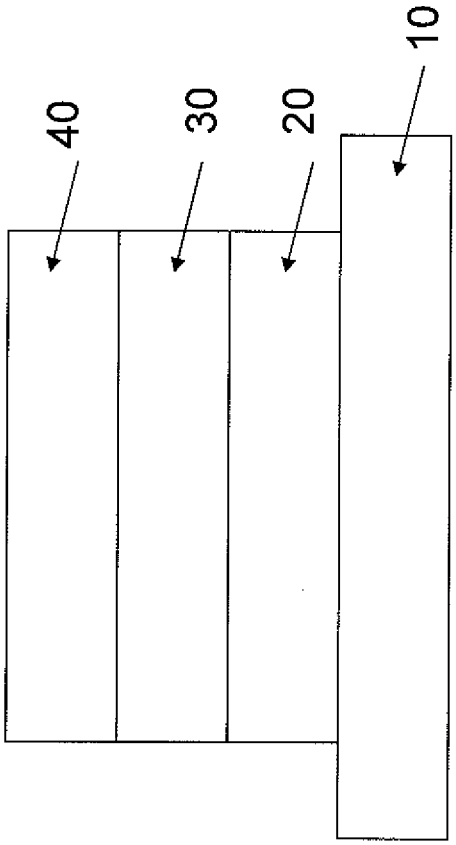


Fig. 1

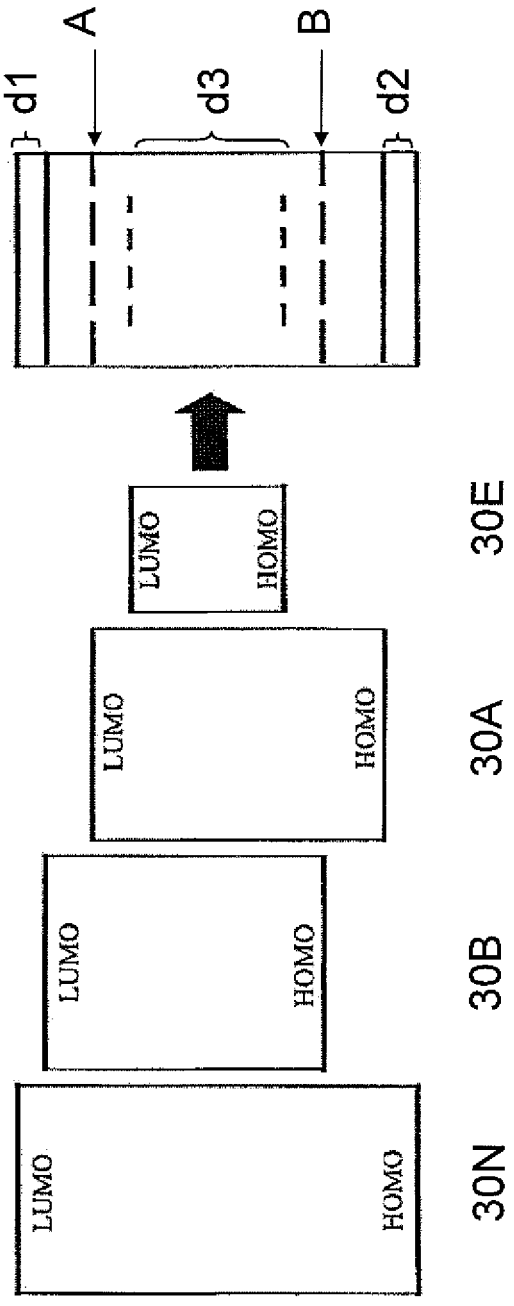


Fig. 2

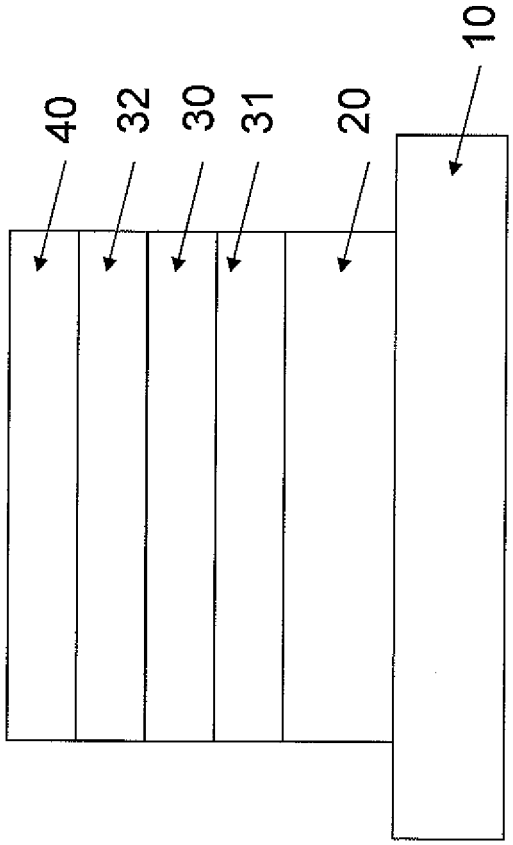


Fig. 3

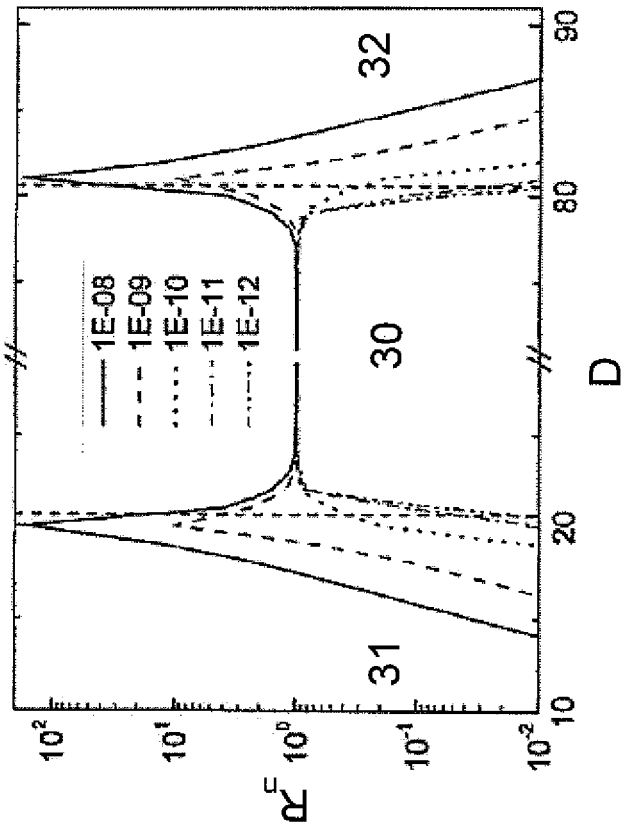

32
30
31
1E-08
1E-09
1E-10
1E-11
1E-12
90
80
20
10
D
10^2
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Fig. 4

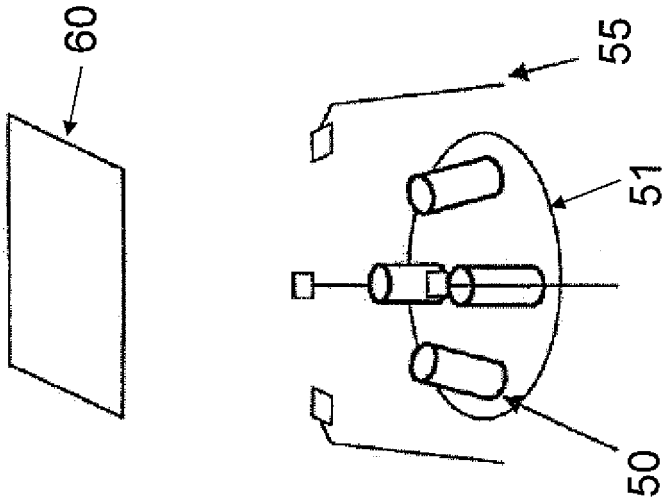


Fig. 5

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re National Phase PCT Application of
Guenter SCHMID et al.
Int'l PCT Serial No.: PCT/DE2009/000701
Int'l Filing Date:: 18 May 2009
For: Electronic Device

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S I R:

In compliance with the duty of disclosure under 37 C.F.R. § 1.56 and in accordance with the practice under 37 C.F.R. §§ 1.97 and 1.98, the Examiner's attention is directed to the documents listed on the enclosed form PTO/SB/08A.

In accordance with 37 C.F.R §§1.97(g) and (h), the filing of this Information Disclosure Statement should not be construed as a representation that a search has been made or that information cited is, or is considered to be, material to patentability as defined in §1.56(b), or that any cited document listed or attached is (or constitutes) prior art. Unless otherwise indicated, the date of publication indicated for an item is taken from the face of the item and Applicant(s) reserve(s) the right to prove that the date of publication is in fact different.

SDC EX. 1002 - 46/325

Submitted herewith is a copy of the International Search Report issued in connection with International Application on which the present U.S. National Phase application is based.

Copies of the references cited in the International Search Report have been supplied by WIPO to the USPTO. Therefore, copies of the cited references in the International Search Report are not being provided herewith in accordance with current U.S. practice because they should be on file already at the USPTO.

It is respectfully requested that the above information be considered by the Examiner and that the copy of the enclosed form PTO/SB/08A be returned indicating that such information has been considered.

Respectfully submitted,
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Dated: November 30, 2010

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)	Application Number	
	Filing Date	
	First Named Inventor	Guenter SCHMID
	Art Unit	
	Examiner Name	
Sheet 1 of 2	Attorney Docket No.	5367-611PUS

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Document Number Number-Kind-Code [2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-2008/0116536	05-22-2008	Forrest et al.	
		US-2002/0101154	08-01-2002	Seo et al.	
		US-2006/0068223	03-30-2006	Nariyuki et al.	
		US-2008/0074038	03-27-2008	Kim et al.	
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	Examiner Name	
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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Foreign Patent Document — Country Code[3]- Number[4]- Kind-Code [5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
		WO 02/074015	09-19-2002	Univ. Princeton, et al.		

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(Artikel 18 sowie Regeln 43 und 44 PCT)

Aktenzeichen des Anmelders oder Anwalts P2008,0612WO	**WEITERES VORGEHEN**	siehe Formblatt PCT/ISA/220 sowie, soweit zutreffend, nachstehender Punkt 5
Internationales Aktenzeichen PCT/DE2009/000701	Internationales Anmeldedatum *(Tag/Monat/Jahr)* 18/05/2009	(Frühestes) Prioritätsdatum *(Tag/Monat/Jahr)* 30/05/2008
Anmelder OSRAM OPTO SEMICONDUCTORS GMBH		

Dieser internationale Recherchenbericht wurde von der Internationalen Recherchenbehörde erstellt und wird dem Anmelder gemäß Artikel 18 übermittelt. Eine Kopie wird dem Internationalen Büro übermittelt.

Dieser Internationale Recherchenbericht umfaßt insgesamt 5 Blätter.

[X] Darüber hinaus liegt ihm jeweils eine Kopie der in diesem Bericht genannten Unterlagen zum Stand der Technik bei.

1. **Grundlage des Berichts**

   a. Hinsichtlich der **Sprache** beruht die Internationale Recherche auf

   [X] der Internationalen Anmeldung in der Sprache, in der sie eingereicht wurde

   [ ] einer Übersetzung der Internationalen Anmeldung in die folgende Sprache _____, bei der es sich um die Sprache der Übersetzung handelt, die für die Zwecke der Internationalen Recherche eingereicht worden ist (Regeln 12.3 a) und 23.1 b)).

   b. [ ] Dieser Internationale Recherchenbericht wurde erstellt unter Berücksichtigung der **Berichtigung eines offensichtlichen Fehlers**, die nach Regel 91 von dieser Behörde genehmigt wurde bzw. dieser Behörde mitgeteilt wurde (Regel 43.6*bis*. (a)).

   c. [ ] Hinsichtlich der in der Internationalen Anmeldung offenbarten **Nucleotid- und/oder Aminosäuresequenz** siehe Feld Nr. I.

2. [ ] **Bestimmte Ansprüche haben sich als nicht recherchierbar erwiesen** (siehe Feld Nr. II).

3. [ ] **Mangelnde Einheitlichkeit der Erfindung** (siehe Feld Nr. III).

4. Hinsichtlich der **Bezeichnung der Erfindung**

   [X] wird der vom Anmelder eingereichte Wortlaut genehmigt.

   [ ] wurde der Wortlaut von der Behörde wie folgt festgesetzt:

5. Hinsichtlich der **Zusammenfassung**

   [ ] wird der vom Anmelder eingereichte Wortlaut genehmigt.

   [X] wurde der Wortlaut nach Regel 38.2b) in der in Feld Nr. IV angegebenen Fassung von der Behörde festgesetzt. Der Anmelder kann der Behörde innerhalb eines Monats nach dem Datum der Absendung dieses internationalen Recherchenberichts eine Stellungnahme vorlegen.

6. Hinsichtlich der **Zeichnungen**

   a. ist folgende Abbildung der **Zeichnungen** mit der Zusammenfassung zu veröffentlichen: Abb. Nr. 2

   [ ] wie vom Anmelder vorgeschlagen

   [ ] wie von der Behörde ausgewählt, weil der Anmelder selbst keine Abbildung vorgeschlagen hat.

   [X] wie von der Behörde ausgewählt, weil diese Abbildung die Erfindung besser kennzeichnet.

   b. [ ] wird keine der Abbildungen mit der Zusammenfassung veröffentlicht.

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INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen

PCT/DE2009/000701

Feld Nr. IV Wortlaut der Zusammenfassung (Fortsetzung von Punkt 5 auf Blatt 1)

Es wird eine Elektronische Vorrichtung, umfassend ein Substrat, eine erste Elektrode, zumindest eine organische, funktionelle Schicht und eine zweite Elektrode angegeben. Die organische, funktionelle Schicht umfasst ein erstes (30W), ein zweites (30B) und ein drittes Matrixmaterial (30A), wobei das erste Matrixmaterial (30N) eine größere Bandlücke als das zweite (30B) und das dritte Matrixmaterial (30A) aufweist.

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INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
PCT/DE2009/000701

A. KLASSIFIZIERUNG DES ANMELDUNGSGEGENSTANDES
INV. H01L51/50

Nach der Internationalen Patentklassifikation (IPC) oder nach der nationalen Klassifikation und der IPC

B. RECHERCHIERTE GEBIETE

Recherchierter Mindestprüfstoff (Klassifikationssystem und Klassifikationssymbole)
H01L H05B

Recherchierte, aber nicht zum Mindestprüfstoff gehörende Veröffentlichungen, soweit diese unter die recherchierten Gebiete fallen

Während der internationalen Recherche konsultierte elektronische Datenbank (Name der Datenbank und evtl. verwendete Suchbegriffe)
EPO-Internal

C. ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
X	US 2008/116536 A1 (FORREST STEPHEN R [US]; YANG FAN [US]) 22. Mai 2008 (2008-05-22) ✓ Absätze [0081] - [0083], [0126]; Abbildungen 9a-h,19	1,3,6,7, 12,13
A	US 2002/101154 A1 (SEO SATOSHI [JP]; YAMAZAKI SHUNPEI [JP]) 1. August 2002 (2002-08-01) ✓ Absätze [0044] - [0056], [0090] - [0094]; Abbildungen 4b,7b	1-15
A	US 2006/068223 A1 (NARIYUKI FUMITO [JP]; YAMAZAKI KAZUKI [JP]) 30. März 2006 (2006-03-30) ✓ Absätze [0028], [0029]	1-15
	-/--	
	In CPI eingepflegt 6.10.09 SAE	

[X] Weitere Veröffentlichungen sind der Fortsetzung von Feld C zu entnehmen [X] Siehe Anhang Patentfamilie

* Besondere Kategorien von angegebenen Veröffentlichungen :
"A" Veröffentlichung, die den allgemeinen Stand der Technik definiert, aber nicht als besonders bedeutsam anzusehen ist
"E" älteres Dokument, das jedoch erst am oder nach dem internationalen Anmeldedatum veröffentlicht worden ist
"L" Veröffentlichung, die geeignet ist, einen Prioritätsanspruch zweifelhaft erscheinen zu lassen, oder durch die das Veröffentlichungsdatum einer anderen im Recherchenbericht genannten Veröffentlichung belegt werden soll oder die aus einem anderen besonderen Grund angegeben ist (wie ausgeführt)
"O" Veröffentlichung, die sich auf eine mündliche Offenbarung, eine Benutzung, eine Ausstellung oder andere Maßnahmen bezieht
"P" Veröffentlichung, die vor dem internationalen Anmeldedatum, aber nach dem beanspruchten Prioritätsdatum veröffentlicht worden ist
"T" Spätere Veröffentlichung, die nach dem internationalen Anmeldedatum oder dem Prioritätsdatum veröffentlicht worden ist und mit der Anmeldung nicht kollidiert, sondern nur zum Verständnis des der Erfindung zugrundeliegenden Prinzips oder der ihr zugrundeliegenden Theorie angegeben ist
"X" Veröffentlichung von besonderer Bedeutung; die beanspruchte Erfindung kann allein aufgrund dieser Veröffentlichung nicht als neu oder auf erfinderischer Tätigkeit beruhend betrachtet werden
"Y" Veröffentlichung von besonderer Bedeutung; die beanspruchte Erfindung kann nicht als auf erfinderischer Tätigkeit beruhend betrachtet werden, wenn die Veröffentlichung mit einer oder mehreren anderen Veröffentlichungen dieser Kategorie in Verbindung gebracht wird und diese Verbindung für einen Fachmann naheliegend ist
"&" Veröffentlichung, die Mitglied derselben Patentfamilie ist

Datum des Abschlusses der internationalen Recherche	Absendedatum des internationalen Recherchenberichts
23. September 2009	05/10/2009

Name und Postanschrift der Internationalen Recherchenbehörde	Bevollmächtigter Bediensteter
Europäisches Patentamt, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Bakos, Tamás

Formblatt PCT/ISA/210 (Blatt 2) (April 2005)

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INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
PCT/DE2009/000701

C. (Fortsetzung) ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
A	WO 02/074015 A (UNIV PRINCETON [US]; UNIV SOUTHERN CALIFORNIA [US]; THOMPSON MARK E [) 19. September 2002 (2002-09-19) Seite 14, Zeile 7 - Seite 15, Zeile 1 ✓ Seite 16, Zeile 8 - Seite 19, Zeile 1; Abbildungen 1,4	1-15
A	US 2008/074038 A1 (KIM HEE-KYUNG [KR]; TAMURA SHINICHIRO [KR]; RAGINI DAS RUPASREE [KR];) 27. März 2008 (2008-03-27) Absätze [0066] - [0088]; Abbildung 3; Tabelle 2 ✓	1-15

In CRI eingepflegt 6.10.09 SDC

2

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INTERNATIONALER RECHERCHENBERICHT

Angaben zu Veröffentlichungen, die zur selben Patentfamilie gehören

Internationales Aktenzeichen
PCT/DE2009/000701

Im Recherchenbericht angeführtes Patentdokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie	Datum der Veröffentlichung
US 2008116536 A1	22-05-2008	AU 2007322040 A1	29-05-2008
		CA 2670466 A1	29-05-2008
		EP 2089921 A2	19-08-2009
		WO 2008063519 A2	29-05-2008
US 2002101154 A1	01-08-2002	CN 1378409 A	06-11-2002
		CN 101159318 A	09-04-2008
		KR 20020064217 A	07-08-2002
		SG 118110 A1	27-01-2006
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		CN 1535483 A	06-10-2004
		EP 1374320 A2	02-01-2004
		JP 2004526284 T	26-08-2004
		TW 540252 B	01-07-2003
US 2008074038 A1	27-03-2008	KR 20080028212 A	31-03-2008

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges Eigentum
Internationales Büro

(43) Internationales Veröffentlichungsdatum
3. Dezember 2009 (03.12.2009)

PCT

(10) Internationale Veröffentlichungsnummer
WO 2009/143807 A1

(51) Internationale Patentklassifikation:
H01L 51/50 (2006.01)

(21) Internationales Aktenzeichen: PCT/DE2009/000701

(22) Internationales Anmeldedatum:
18. Mai 2009 (18.05.2009)

(25) Einreichungssprache: Deutsch

(26) Veröffentlichungssprache: Deutsch

(30) Angaben zur Priorität:
10 2008 025 920.9 30. Mai 2008 (30.05.2008) DE
10 2008 039 361.4
22. August 2008 (22.08.2008) DE

(71) Anmelder *(für alle Bestimmungsstaaten mit Ausnahme von US)*: **OSRAM OPTO SEMICONDUCTORS GMBH** [DE/DE]; Leibnizstrasse 4, 93055 Regensburg (DE).

(72) Erfinder; und

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(74) Anwalt: **EPPING HERMANN FISCHER PATENTANWALTSGESELLSCHAFT MBH**; Ridlerstrasse 55, 80339 München (DE).

(81) Bestimmungsstaaten *(soweit nicht anders angegeben, für jede verfügbare nationale Schutzrechtsart)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

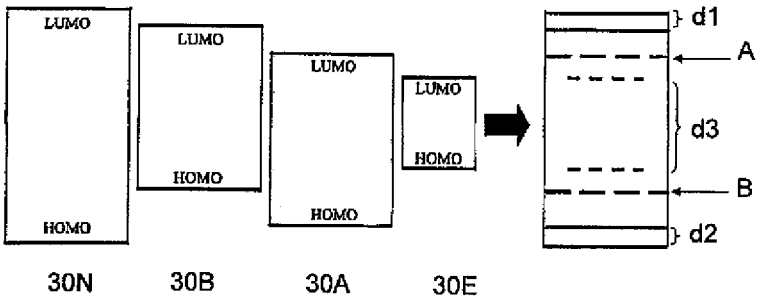
(84) Bestimmungsstaaten *(soweit nicht anders angegeben, für jede verfügbare regionale Schutzrechtsart)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), eurasisches (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI,

[Fortsetzung auf der nächsten Seite]

(54) Title: ELECTRONIC DEVICE

(54) Bezeichnung: ELEKTRONISCHE VORRICHTUNG

Fig. 2



(57) Abstract: An electronic device is specified, comprising a substrate, a first electrode, at least one organic functional layer and a second electrode. The organic functional layer comprises a first (30W), a second (30B) and a third matrix material (30A), wherein the first matrix material (30N) has a larger band gap than the second (30B) and the third matrix material (30A).

(57) Zusammenfassung: Es wird eine elektronische Vorrichtung, umfassend ein Substrat, eine erste Elektrode, zumindest eine organische, funktionelle Schicht und eine zweite Elektrode angegeben. Die organische, funktionelle Schicht umfasst ein erstes (30W), ein zweites (30B) und ein drittes Matrixmaterial (30A), wobei das erste Matrixmaterial (30N) eine grössere Bandlücke als das zweite (30B) und das dritte Matrixmaterial (30A) aufweist.

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PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

SECOND AND SUPPLEMENTARY NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION (TO DESIGNATED OFFICES WHICH APPLY THE 30 MONTH TIME LIMIT UNDER ARTICLE 22(1))

(PCT Rule 47.1(c))

To:

EPPING HERMANN FISCHER
PATENTANWALTSGESELLSCHAFT MBH
Ridlerstrasse 55
80339 München
ALLEMAGNE

Date of mailing *(day/month/year)*
30 September 2010 (30.09.2010)

Applicant's or agent's file reference
P2008,0612WO

IMPORTANT NOTICE

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/DE2009/000701	18 May 2009 (18.05.2009)	30 May 2008 (30.05.2008)

Applicant
OSRAM OPTO SEMICONDUCTORS GMBH et al

1. **ATTENTION**: For any designated Office(s), for which the time limit under Article 22(1), as in force from 1 April 2002 (30 months from the priority date), **does not apply**, please see Form PCT/IB/308(First Notice) issued previously.

2. Notice is hereby given that the following designated Office(s), for which the time limit under Article 22(1), as in force from 1 April 2002, **does apply**, has/have requested that the communication of the international application, as provided for in Article 20, be effected under Rule 93*bis*.1. The International Bureau has effected that communication on the date indicated below:
03 December 2009 (03.12.2009)

   AU, AZ, BY, CN, CO, DZ, EP, HU, KG, KP, KR, MD, MK, MY, MZ, NA, NG, PG, RU, SY, TM, US

   In accordance with Rule 47.1(c-*bis*)(i), those Offices will accept the present notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

3. The following designated Offices, for which the time limit under Article 22(1), as in force from 1 April 2002, **does apply**, have not requested, as at the time of mailing of the present notice, that the communication of the international application be effected under Rule 93*bis*.1 :

   AE, AG, AL, AM, AO, AP, AT, BA, BB, BG, BH, BR, BW, BZ, CA, CH, CR, CU, CZ, DK, DM, DO, EA, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, ID, IL, IN, IS, JP, KE, KM, KN, KZ, LA, LC, LK, LR, LS, LT, LY, MA, ME, MG, MN, MW, MX, NI, NO, NZ, OA, OM, PH, PL, PT, RO, RS, SC, SD, SE, SG, SK, SL, SM, ST, SV, TJ, TN, TR, TT, UA, UZ, VC, VN, ZA, ZM, ZW

   In accordance with Rule 47.1(c-*bis*)(ii), those Offices accept the present notice as conclusive evidence that the Contracting State for which that Office acts as a designated Office does not require the furnishing, under Article 22, by the applicant of a copy of the international application.

4. **TIME LIMITS for entry into the national phase**

   For the designated or elected Office(s) listed above, the applicable time limit for entering the national phase will, **subject to what is said in the following paragraph,** be **30 MONTHS** from the priority date.

   In practice, **time limits other than the 30-month time limit** will continue to apply, for various periods of time, in respect of certain of the designated or elected Office(s) listed above. For **regular updates on the applicable time limits** (30 or 31 months, or other time limit), Office by Office, refer to the *PCT Gazette*, the *PCT Newsletter* and the *PCT Applicant's Guide*, Volume II, National Chapters, all available from WIPO's Internet site, at http://www.wipo.int/pct/en/index.html.

   It is the applicant's **sole responsibility** to monitor all these time limits.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. +41 22 338 82 70

Authorized officer
Agnes Wittmann-Regis

e-mail: pt06.pct@wipo.int

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING
SUBMISSION OR TRANSMITTAL
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

EPPING HERMANN FISCHER
PATENTANWALTSGESELLSCHAFT MBH
Ridlerstrasse 55
80339 München
ALLEMAGNE

Date of mailing *(day/month/year)* 29 September 2009 (29.09.2009)	
Applicant's or agent's file reference P2008,0612WO	**IMPORTANT NOTIFICATION**
International application No. PCT/DE2009/000701	International filing date *(day/month/year)* 18 May 2009 (18.05.2009)
International publication date *(day/month/year)* **Not yet published**	Priority date *(day/month/year)* 30 May 2008 (30.05.2008)
Applicant OSRAM OPTO SEMICONDUCTORS GMBH et al	

1. By means of this Form, which replaces any previously issued notification concerning submission or transmittal of priority documents, the applicant is hereby notified of the date of receipt by the International Bureau of the priority document(s) relating to all earlier application(s) whose priority is claimed. Unless otherwise indicated by the letters "NR", in the right-hand column or by an asterisk appearing next to a date of receipt, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).

2. *(If applicable)* The **letters "NR"** appearing in the right-hand column denote **a priority document which, on the date of mailing of this Form, had not yet been received by the International Bureau** under Rule 17.1(a) or (b). Where, under Rule 17.1(a), the priority document must be submitted by the applicant to the receiving Office or the International Bureau, but the applicant fails to submit the priority document within the applicable time limit under that Rule, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

3. *(If applicable)***An asterisk (*)** appearing next to a date of receipt, in the right-hand column, denotes **a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b)** (the priority document was received after the time limit prescribed in Rule 17.1(a) or the request to prepare and transmit the priority document was submitted to the receiving Office after the applicable time limit under Rule 17.1(b)). Even though the priority document was not furnished in compliance with Rule 17.1(a) or (b), the International Bureau will nevertheless transmit a copy of the document to the designated Offices, for their consideration. In case such a copy is not accepted by the designated Office as the priority document, Rule 17.1(c) provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
30 May 2008 (30.05.2008)	10 2008 025 920.9	DE	25 September 2009 (25.09.2009)
22 August 2008 (22.08.2008)	10 2008 039 361.4	DE	16 September 2009 (16.09.2009)

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. +41 22 338 82 70

Authorized officer
Agnes Wittmann-Regis
e-mail PT06.PCT@WIPO.INT
Telephone No. +41 22 338 74 06

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VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS

Absender: INTERNATIONALE RECHERCHENBEHÖRDE

An:

siehe Formular PCT/ISA/220

PCT

SCHRIFTLICHER BESCHEID DER INTERNATIONALEN RECHERCHENBEHÖRDE

(Regel 43*bis*.1 PCT)

Absendedatum (*Tag/Monat/Jahr*) 210 (Blatt 2)	siehe Formular PCT/ISA/
Aktenzeichen des Anmelders oder Anwalts: siehe Formular PCT/ISA/220	**WEITERES VORGEHEN** siehe Punkt 2 unten

Internationales Aktenzeichen	Internationales Anmeldedatum (*Tag/Monat/Jahr*)	Prioritätsdatum (*Tag/Monat/Jahr*)
PCT/DE2009/000701	18.05.2009	30.05.2008

Internationale Patentklassifikation (IPC) oder nationale Klassifikation und IPC
INV. H01L51/50

Anmelder
OSRAM OPTO SEMICONDUCTORS GMBH

1. Dieser Bescheid enthält Angaben zu folgenden Punkten:

- ☒ Feld Nr. I Grundlage des Bescheids
- ☐ Feld Nr. II Priorität
- ☐ Feld Nr. III Keine Erstellung eines Gutachtens über Neuheit, erfinderische Tätigkeit und gewerbliche Anwendbarkeit
- ☐ Feld Nr. IV Mangelnde Einheitlichkeit der Erfindung
- ☒ Feld Nr. V Begründete Feststellung nach Regel 43*bis*.1 a) i) hinsichtlich der Neuheit, der erfinderischen Tätigkeit und der gewerblichen Anwendbarkeit; Unterlagen und Erklärungen zur Stützung dieser Feststellung
- ☐ Feld Nr. VI Bestimmte angeführte Unterlagen
- ☐ Feld Nr. VII Bestimmte Mängel der internationalen Anmeldung
- ☐ Feld Nr. VIII Bestimmte Bemerkungen zur internationalen Anmeldung

2. **WEITERES VORGEHEN**

Wird ein Antrag auf internationale vorläufige Prüfung gestellt, so gilt dieser Bescheid als schriftlicher Bescheid der mit der internationalen vorläufigen Prüfung beauftragten Behörde ("IPEA"); dies trifft nicht zu, wenn der Anmelder eine andere Behörde als diese als IPEA wählt und die gewählte IPEA dem Internationale Büro nach Regel 66.1*bis* b) mitgeteilt hat, dass schriftliche Bescheide dieser Internationalen Recherchenbehörde nicht anerkannt werden.

Wenn dieser Bescheid wie oben vorgesehen als schriftlicher Bescheid der IPEA gilt, so ist der Anmelder aufgefordert, bei der IPEA vor Ablauf von 3 Monaten ab dem Tag, an dem das Formblatt PCT/ISA/220 abgesandt wurde oder vor Ablauf von 22 Monaten ab dem Prioritätsdatum, je nachdem, welche Frist später abläuft, eine schriftliche Stellungnahme und, wo dies angebracht ist, Änderungen einzureichen.

Weitere Optionen siehe Formblatt PCT/ISA/220.

3. Nähere Einzelheiten siehe die Anmerkungen zu Formblatt PCT/ISA/220.

Name und Postanschrift der Internationalen Recherchenbehörde	Datum der Fertigstellung dieses Bescheids	Bevollmächtigter Bediensteter
Europäisches Patentamt P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Fax: +31 70 340 - 3016	siehe Formular PCT/ISA/210	Bakos, Tamás Tel. +31 70 340-4818

Formblatt PCT/ISA/237 (Deckblatt) (April 2005)

SCHRIFTLICHER BESCHEID DER INTERNATIONALEN RECHERCHEBEHÖRDE

Internationales Aktenzeichen
PCT/DE2009/000701

Feld Nr. I Grundlage des Bescheids

1. Hinsichtlich der **Sprache** beruht der Bescheid auf

   ☒ der internationalen Anmeldung in der Sprache, in der sie eingereicht wurde

   ☐ einer Übersetzung der internationalen Anmeldung in die folgende Sprache , bei der es sich um die Sprache der Übersetzung handelt, die für die Zwecke der internationalen Recherche eingereicht worden ist (Regeln 12.3 a) und 23.1 b)).

2. ☐ Dieser Bescheid wurde erstellt unter Berücksichtigung der **Berichtigung eines offensichtlichen Fehlers**, die nach Regel 91 von dieser Behörde genehmigt wurde bzw. dieser Behörde mitgeteilt wurde (Regel 43bis.1 a)).

3. Hinsichtlich der **Nucleotid- und/oder Aminosäuresequenz**, die in der internationalen Anmeldung offenbart wurde und für die beanspruchte Erfindung erforderlich ist, ist der Bescheid auf folgender Grundlage erstellt worden:

   a. Art des Materials:

      ☐ Sequenzprotokoll

      ☐ Tabelle(n) zum Sequenzprotokoll

   b. Form des Materials:

      ☐ in Papierform

      ☐ in elektronischer Form

   c. Zeitpunkt der Einreichung:

      ☐ in der eingereichten internationalen Anmeldung enthalten

      ☐ zusammen mit der internationalen Anmeldung in elektronischer Form eingereicht

      ☐ bei der Behörde nachträglich für die Zwecke der Recherche eingereicht

4. ☐ Wurden mehr als eine Version oder Kopie eines Sequenzprotokolls und/oder einer dazugehörigen Tabelle eingereicht, so sind zusätzlich die erforderlichen Erklärungen, dass die Information in den nachgereichten oder zusätzlichen Kopien mit der Information in der Anmeldung in der eingereichten Fassung übereinstimmt bzw. nicht über sie hinausgeht, vorgelegt worden.

5. Zusätzliche Bemerkungen:

Feld Nr. V Begründete Feststellung nach Regel 43*bis*.1 a) i) hinsichtlich der Neuheit, der erfinderischen Tätigkeit und der gewerblichen Anwendbarkeit; Unterlagen und Erklärungen zur Stützung dieser Feststellung

1. Feststellung

Neuheit	Ja:	Ansprüche 2,4,5,8-12,14,15
	Nein:	Ansprüche 1,3,6,7,13
Erfinderische Tätigkeit	Ja:	Ansprüche 2,4,5,8-11,14,15
	Nein:	Ansprüche 1,3,6,7,12,13
Gewerbliche Anwendbarkeit	Ja:	Ansprüche: 1-15
	Nein:	Ansprüche:

2. Unterlagen und Erklärungen:

siehe Beiblatt

Zu Punkt V.

1 Es wird auf das folgende Dokument verwiesen:

D1 : US 2008/116536 A1 (FORREST STEPHEN R [US]; YANG FAN [US]) 22. Mai 2008 (2008-05-22)

2 UNABHÄNGIGER ANSPRUCH 1

2.1 Die vorliegende Anmeldung erfüllt nicht die Erfordernisse des Artikels 33(1) PCT, weil der Gegenstand des Anspruchs 1 im Sinne von Artikel 33(2) PCT nicht neu ist.

Dokument D1 offenbart (die Verweise in Klammern beziehen sich auf dieses Dokument):

- eine elektronische Vorrichtung, umfassend
- ein Substrat (D1: Abb. 9a, Bezugszeichen 110),
- eine erste Elektrode (D1: Abb. 9a, Bezugszeichen 120),
- zumindest eine organische, funktionelle Schicht (D1: Abs. 19,81-83, Abb. 9h, Bezugszeichen 953a-d), und
- eine zweite Elektrode (D1: Abb. 9h, Bezugszeichen 170),
- wobei die zumindest eine organische, funktionelle Schicht zwischen der ersten Elektrode und der zweiten Elektrode angeordnet ist und wobei die zumindest eine organische, funktionelle Schicht mindestens ein erstes Matrixmaterial (D1: Abs. 81, 126, Abb. 9h, Bezugszeichen 953a und Abb. 19, Donormaterial CuPc), ein zweites Matrixmaterial (D1: Abs. 81, 126, Abb. 9h, Bezugszeichen 953b und Abb. 19, Sensibilisator SnPc) und ein drittes Matrixmaterial (D1: Abs. 81, 126, Abb. 9h, Bezugszeichen 953c und Abb. 19, Akzeptormaterial C_{60}) aufweist
- und das dritte Matrixmaterial ein Lowest Unoccupied Molecular Orbital (LUMO), das energetisch niedriger als das LUMO des zweiten Matrixmaterials und das LUMO des ersten Matrixmaterials ist, und wobei das zweite Matrixmaterial ein Highest Occupied Molecular Orbital (HOMO), das energetisch höher als das HOMO des ersten Matrixmaterials und das HOMO des dritten Matrixmaterials ist, aufweist (D1: Abb. 19).

2.2 Folglich ist der Gegenstand des Anspruchs 1 nicht neu (Art. 33(2) PCT).

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3 UNABHÄNGIGER ANSPRUCH 14

Das Dokument D1 wird als nächstliegender Stand der Technik gegenüber dem Gegenstand des Anspruchs 14 angesehen. Es offenbart ein Verfahren zur Herstellung einer elektronischen Vorrichtung gemäß z.B. Anspruch 1 (siehe D1: Abs. 81-83, Abb. 9a-h) in dem die im Teil 2.1 erwähnte Bauteile mit herkömmlichen Verfahrensschritten nacheinander geformt werden.

Der Gegenstand des Anspruchs 14 unterscheidet sich daher von dem aus D1 bekannten Verfahren dadurch, daß die drei Matrixmateriale gleichzeitig aufgebracht werden.

Der Gegenstand des Anspruchs 14 ist somit neu (Artikel 33(2) PCT).

Die in Anspruch 14 der vorliegenden Erfindung zu lösende Aufgabe kann somit darin gesehen werden, eine elektronische Vorrichtung mit einem beliebigen Verhältnis zwischen Loch- und Elektronentransport zu schaffen.

Die in Anspruch 14 der vorliegenden Anmeldung für diese Aufgabe vorgeschlagene Lösung beruht aus den folgenden Gründen auf einer erfinderischen Tätigkeit (Artikel 33(3) PCT):

Nach Dokument D1: Abs. 26,81-83 müssen die drei Matrixmateriale (D1: Abb. 9h, Bezugszeichen 953a-c) nacheinander abgeschieden werden um die drei Matrizen der Nanokristalle Abb. 9h: Bezugszeichen 953a-c formen zu können. Ein gleichzeitiges Abscheiden der drei Matrixmaterialen würde den Wachstum der Kristalle zerstören. Folglich würde der Fachmann die obige Matrixmateriale nicht gleichzeitig aufbringen.

Der Anspruch 15 ist vom Anspruch 14 abhängig und erfüllt damit ebenfalls die Erfordernisse des PCT in bezug auf Neuheit und erfinderische Tätigkeit.

4 ABHÄNGIGE ANSPRÜCHE 3,6,7,12,13

Die Ansprüche 3,6,7,12,13 enthalten keine Merkmale, die in Kombination mit den Merkmalen irgendeines Anspruchs, auf den sie sich beziehen, die Erfordernisse des PCT in Bezug auf Neuheit bzw. erfinderische Tätigkeit erfüllen. Die Gründe dafür sind die folgenden:

4.1 Dokument D1: Abs. 19-21,81-83,126, Abb. 9a-h,19 offenbart auch den Gegenstand der Ansprüche 3,6,7,13. Folglich ist der Gegenstand der Ansprüche 3,6,7,13 nicht neu (Art. 33(2) PCT).

4.2 Es ist bekannt, das organische Solarzellen und organische lichtemittierende Dioden (OLED) denselben Aufbau haben, und durch Anlegen einer Spannung mit entgegengesetzter Polarität können die Solarzellen (wie z.B., in D1: Abb. 10) als eine OLED betrieben werden. Folglich kann der Gegenstand des Anspruchs 12 nicht als erfinderisch betrachtet werden (Art. 33(3) PCT).

5 ABHÄNGIGE ANSPRÜCHE 2,4,5,8-11

Die in den abhängigen Ansprüchen enthaltene 2,4,5,8-11 Merkmalskombination ist aus dem vorliegenden Stand der Technik weder bekannt, noch wird sie durch ihn nahegelegt. Die Gründe dafür sind die folgenden:

5.1 In der farbstoffsensibilizierten Solarzelle von D1: Abb. 9h spielt das erste Matrixmaterial die Rolle des Donors (es kann als Lochtransportmaterial angesehen werden), das zweite Matrixmaterial die Matrixmaterial die Rolle des Sensibilisators, und das dritte Matrixmaterial die Rolle des Akzeptors (es kann als Elektronentransportmaterial angesehen werden). Dem Fachmann ist es aus dem vorliegenden Stand der Technik nicht naheliegend diese Materiale so zu ändern, dass eine elektronische Vorrichtung mit den in den Ansprüchen 2,4,5,8-11 beschriebenen Bandstruktur oder Funktion gebaut werden könnte.

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Mögliche Schritte nach Erhalt des internationalen Recherchenberichts (ISR) und des schriftlichen Bescheids der Internationalen Recherchenbehörde (WO-ISA)

Allgemeine Hinweise	Zu allen am oder nach dem 1.1.2004 eingereichten internationalen Anmeldungen erstellt die zuständige internationale Recherchenbehörde (ISA) zusammen mit dem internationalen Recherchenbericht (ISR) einen schriftlichen Bescheid (WO-ISA). Anders als der frühere schriftliche Bescheid der mit der internationalen vorläufigen Prüfung beauftragten Behörde (IPEA) (Regel 66.2 PCT) muß der WO-ISA vom Anmelder nicht beantwortet werden, sondern wird lediglich im weiteren Verfahrensverlauf berücksichtigt. In diesem Dokument werden die möglichen Schritte erläutert.
Änderung der Ansprüche gemäß Artikel 19 PCT	Innerhalb von 2 Monaten nach dem Datum der Absendung des ISR und des WO-ISA kann der Anmelder gemäß Artikel 19 PCT unmittelbar beim Internationalen Büro der WIPO geänderte Ansprüche einreichen. An diesem Verfahren hat sich durch die PCT-Reform im Jahr 2004 nichts geändert. Nähere Informationen sind Regel 46 PCT sowie dem Formblatt PCT/ISA/220 und den Anmerkungen zu diesem Formblatt zu entnehmen.
Antrag auf internationale vorläufige Prüfung	Grundsätzlich gilt der WO-ISA als schriftlicher Bescheid der IPEA. Daher dürfte es in vielen Fällen nicht notwendig sein, einen Antrag auf internationale vorläufige Prüfung zu stellen. Wünscht der Anmelder dies dennoch, so ist der Antrag vor Ablauf einer Frist von 3 Monaten ab dem Tag an dem ISR/WO-ISA übermittelt werden, oder von 22 Monaten ab dem Prioritätsdatum zu stellen, je nachdem, welche Frist später abläuft (Regel 54bis PCT). Änderungen nach Artikel 34 PCT können wie bisher bei der IPEA eingereicht werden, normalerweise bei Antragstellung (Regel 66.1 b) PCT). Wurde eine internationale vorläufige Prüfung beantragt und wurden keine Stellungnahmen/Änderungen eingereicht, so wandelt die IPEA den WO-ISA in einen IPRP (internationaler vorläufiger Bericht zur Patentfähigkeit) um, der im Wesentlichen den Inhalt des WO-ISA wiederspiegelt. Die Zurücknahme des Antrags auf internationale vorläufige Prüfung ist immer noch möglich (Artikel 37 PCT).
Einreichung einer informellen Stellungnahme	Nach Erhalt des ISR/WO-ISA kann der Anmelder unmittelbar beim Internationalen Büro der WIPO informell zum WO-ISA Stellung nehmen. Diese Stellungnahme wird den Bestimmungsämtern zusammen mit dem IPRP (internationaler vorläufiger Bericht zur Patentfähigkeit) nach Ablauf von 30 Monaten ab dem Prioritätsdatum übermittelt. Siehe auch nächster Abschnitt.
Ende der internationalen Phase	Am Ende der internationalen Phase wandelt das Internationale Büro der WIPO den WO-ISA (oder, wenn ein Prüfungsantrag gestellt wurde, den schriftlichen Bescheid der IPEA) in einen IPRP um, der dann ggf. mit der informellen Stellungnahme den Bestimmungsämtern übermittelt wird. Der IPRP ersetzt den früheren IPER (internationaler vorläufiger Prüfungsbericht).
Einschlägige PCT-Regeln & weitere Informationsquellen	Regel 43 PCT, Regel 43bis PCT, Regel 44 PCT, Regel 44bis PCT, PCT Newsletter 12/2003, ABl. 11/2003, ABl. 12/2003

SDC EX. 1002 - 64/325

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	Electronic Device
First Named Inventor/Applicant Name:	Guenter SCHMID
Filer:	Edward M. Weisz/yolanda usher
Attorney Docket Number:	5367-611PUS

Filed as Large Entity

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
National Stage Fee	1631	1	330	330
Natl Stage Search Fee - Report provided	1642	1	430	430
National Stage Exam - all other cases	1633	1	220	220
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**980**

Electronic Acknowledgement Receipt

EFS ID:	8938954
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	20101130205724.pdf	111713 2f2dc539c8f5ec6090138f8b3cde20cf34a9570c	no	3
Warnings:					
Information:					
2	Application Data Sheet	20101130205738.pdf	74383 85a1d2d1578ef6f80cace916f79f16b8952d3d9c	no	7
Warnings:					
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3	Preliminary Amendment	20101130205755.pdf	145794 2165ba6aeb45018128d35c76f569d3dba51f8530	no	8
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Information:					
4		20101130210327.pdf	589194 add73d947848a93f803a44c34b06739de8b3e414	yes	27

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	18
Claims	19	21
Abstract	22	22
Drawings-only black and white line drawings	23	27

Warnings:					
Information:					
5	Transmittal Letter	20101130210634.pdf	37426 4520557531491990dc980c071f23ea9b4f954898	no	2
Warnings:					
Information:					
6	Information Disclosure Statement (IDS) Filed (SB/08)	20101130210648.pdf	72954 ff834d99c74621ad58d1b0e137658ed6854354f2	no	2
Warnings:					

Information:					
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7	Foreign Reference	20101130210701.pdf	141035 978cf67d64691b3168da3e7864d5c61869a7f0ce	no	5
Warnings:					
Information:					
8	Documents submitted with 371 Applications	20101130211323.pdf	392267 afcff236383dd0e3046ad85d96ebff14f9120811	no	10
Warnings:					
Information:					
9	Fee Worksheet (PTO-875)	fee-info.pdf	33066 f634d20783a310195915 0f653ba3122920dd3d2f	no	2
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<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

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(81) Bestimmungsstaaten *(soweit nicht anders angegeben, für jede verfügbare nationale Schutzrechtsart)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

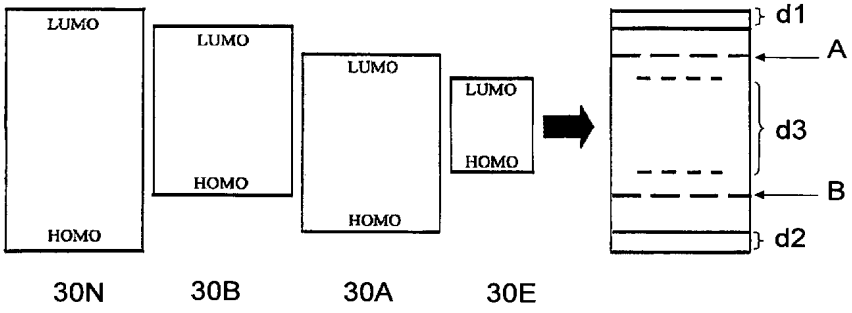
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[Fortsetzung auf der nächsten Seite]

(54) **Title**: ELECTRONIC DEVICE

(54) **Bezeichnung**: ELEKTRONISCHE VORRICHTUNG

Fig. 2



(57) **Abstract**: An electronic device is specified, comprising a substrate, a first electrode, at least one organic functional layer and a second electrode. The organic functional layer comprises a first (30W), a second (30B) and a third matrix material (30A), wherein the first matrix material (30N) has a larger band gap than the second (30B) and the third matrix material (30A).

(57) **Zusammenfassung**: Es wird eine elektronische Vorrichtung, umfassend ein Substrat, eine erste Elektrode, zumindest eine organische, funktionelle Schicht und eine zweite Elektrode angegeben. Die organische, funktionelle Schicht umfasst ein erstes (30W), ein zweites (30B) und ein drittes Matrixmaterial (30A), wobei das erste Matrixmaterial (30N) eine grössere Bandlücke als das zweite (30B) und das dritte Matrixmaterial (30A) aufweist.

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SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Veröffentlicht:

— *mit internationalem Recherchenbericht (Artikel 21 Absatz 3)*

— *vor Ablauf der für Änderungen der Ansprüche geltenden Frist; Veröffentlichung wird wiederholt, falls Änderungen eingehen (Regel 48 Absatz 2 Buchstabe h)*

Beschreibung

Elektronische Vorrichtung

Die Erfindung betrifft eine Elektronische Vorrichtung und ein Verfahren zur Herstellung einer elektronischen Vorrichtung.

Diese Patentanmeldung beansprucht die Prioritäten der deutschen Patentanmeldung 10 2008 025 920.9 und der deutschen Patentanmeldung 10 2008 039 361.4, deren Offenbarungsgehalte hiermit durch Rückbezug aufgenommen werden.

Elektronische Vorrichtungen, wie beispielsweise organische Leuchtdioden (OLEDs), bestehen aus einer Abfolge mehrerer funktioneller organischer Schichten. Emissionsschichten weisen dabei ein Matrixmaterial auf, welches mit Emittermolekülen dotiert wird. In der Emissionsschicht werden Exzitonen durch Rekombination von Elektronen und „Löchern" gebildet, die zur Lichtemission führen. Um eine hohe Effizienz der elektronischen Vorrichtung zu erhalten, ist das Verhältnis zwischen Elektronen und „Löchern", die in der Emissionsschicht transportiert werden, entscheidend. Ein nicht ausgeglichenes Verhältnis zwischen Loch- und Elektronentransport resultiert in einer geringen Strahlungseffizienz der Vorrichtung.

Aufgabe der Erfindung ist es, eine elektronische Vorrichtung bereitzustellen, die einen verbesserten Ladungsträgertransport und eine verbesserte Ladungsträger-balance in den organischen Schichten und damit eine erhöhte Effizienz aufweist. Eine weitere Aufgabe der Erfindung ist es, ein Verfahren zur Herstellung einer elektronischen Vorrichtung bereitzustellen. Diese Aufgaben werden durch eine

elektronische Vorrichtung gemäß Anspruch 1 und einem Verfahren zur Herstellung der elektronischen Vorrichtung gemäß Anspruch 12 gelöst. Weitere Ausführungsformen der Vorrichtung und des Verfahrens sind Gegenstand weiterer Ansprüche.

Gemäß einer Ausführungsform wird eine elektronische Vorrichtung bereitgestellt, die ein Substrat, eine erste Elektrode, zumindest eine organische, funktionelle Schicht und eine zweite Elektrode umfasst, wobei die zumindest eine organische funktionelle Schicht zwischen der ersten Elektrode und der zweiten Elektrode angeordnet ist. Beispielsweise kann die erste Elektrode auf dem Substrat, die zumindest eine organische funktionelle Schicht auf der ersten Elektrode und die zweite Elektrode auf der zumindest einen organischen, funktionellen Schicht angeordnet sein. Die zumindest eine organische, funktionelle Schicht weist mindestens ein erstes Matrixmaterial, ein zweites Matrixmaterial und ein drittes Matrixmaterial auf, wobei das dritte Matrixmaterial ein Lowest Unoccupied Molecular Orbital (LUMO), das energetisch niedriger als das LUMO des zweiten Matrixmaterials und das LUMO des ersten Matrixmaterials ist, und wobei das zweite Matrixmaterial ein Highest Occupied Molecular Orbital (HOMO), das energetisch höher als das HOMO des ersten Matrixmaterials und das HOMO des dritten Matrixmaterials ist. Damit wird eine elektronische Vorrichtung bereitgestellt, die mehr als zwei verschiedene Matrixmaterialien in einer organischen funktionellen Schicht umfasst. Dabei können drei verschiedene Matrixmaterialien vorhanden sein, je nach Bedarf auch mehr als drei.

Nach der Molekülorbitaltheorie sind in einem Molekül verschiedene Molekülorbitale mit verschiedenen Energieniveaus

vorhanden, die von den vorhandenen Elektronen besetzt werden können. Diese Molekülorbitale werden nach zunehmendem Energieniveau besetzt. Das LUMO ist das energetisch niedrigste Molekülorbital, das nicht mehr mit einem Elektron besetzt ist. Das HOMO ist das energetisch am höchsten gelegene Molekülorbital, das noch mit einem Elektron besetzt ist.

Diese elektronische Vorrichtung weist einen verbesserten Ladungsträgertransport und eine verbesserte Ladungsträgerbalance in der organischen funktionellen Schicht auf, und ein anpassbares Verhältnis zwischen Loch- und Elektronentransport. Das erste Matrixmaterial ist dabei so gewählt, dass es eine große Bandlücke, also die Differenz zwischen HOMO und LUMO aufweist, beispielsweise so dass sein HOMO energetisch unter dem HOMO der anderen beiden Matrixmaterialien und sein LUMO energetisch über dem LUMO der anderen beiden Matrixmaterialien liegt.

Weiterhin kann das erste Matrixmaterial ein LUMO aufweisen, das energetisch höher als das LUMO des zweiten Matrixmaterials und das LUMO des dritten Matrixmaterials ist, und ein HOMO, das energetisch niedriger als das HOMO des zweiten Matrixmaterials und das HOMO des dritten Matrixmaterials ist.

Weiterhin kann in der elektronischen Vorrichtung das zweite Matrixmaterial ein LUMO, das energetisch höher als das LUMO des dritten Matrixmaterials ist, und ein HOMO, das energetisch höher als das HOMO des dritten Matrixmaterials ist, aufweisen. Damit kann das erste Matrixmaterial die größte Bandlücke zwischen HOMO und LUMO im Vergleich zum zweiten und zum dritten Matrixmaterial aufweisen und das

zweite Matrixmaterial weist eine Bandlücke auf, die zu der Bandlücke des dritten Matrixmaterials energetisch verschoben ist. Damit können auf dem LUMO des dritten Matrixmaterials Elektronen transportiert werden, und auf dem HOMO des zweiten Matrixmaterials Löcher transportiert werden, da diese Energieniveaus jeweils am energetisch günstigsten für den jeweiligen Ladungstransport sind.

Das erste Matrixmaterial kann in der elektronischen Vorrichtung eine Ladungsträgermobilität aufweisen, die geringer ist als die Ladungsträgermobilität des zweiten und des dritten Matrixmaterials. Das erste Matrixmaterial kann ein Ultra Wide Band Gap (UGH)-Material sein, welches eine im Vergleich zu den übrigen Matrixmaterialien große Bandlücke aufweist. Dadurch kann es keinen Anteil am Ladungsträgertransport aufweisen.

Das zweite Matrixmaterial kann weiterhin ein Lochtransportmaterial umfassen und das dritte Matrixmaterial kann ein Elektronentransportmaterial umfassen.

Der Ladungsträgertransport, also der Lochtransport und der Elektronentransport, hängt insbesondere von der Mobilität der Löcher beziehungsweise der Elektronen in einem Material und von der Lage der Energieniveaus HOMO und LUMO der Matrixmaterialien ab. Das HOMO und LUMO eines Materials ist dabei für die Ladungsträgerinjektion verantwortlich.

Zur Erzeugung eines Lochs in der Matrix, die sich aus den drei Matrixmaterialien zusammensetzt, muss beispielsweise ein Elektron aus dem HOMO entfernt werden, was bei einem energetisch tief liegenden HOMO schwieriger ist als bei einem energetisch höher liegenden. Somit ist das zweite

Matrixmaterial, das ein höher gelegenes HOMO als das dritte Matrixmaterial aufweist, besser als Lochtransportmaterial geeignet, als das dritte Matrixmaterial. Analoges gilt für die Erzeugung von Elektronen in LUMOs, die bei energetisch tiefer gelegenen LUMOs energetisch begünstigt ist. Somit eignet sich das dritte Matrixmaterial, das ein niedrigeres LUMO als das zweite Matrixmaterial aufweist, als Elektronentransportmaterial.

Sind Löcher und Elektronen erzeugt, spielt weiterhin die Mobilität dieser Ladungsträger in dem Material eine Rolle. Je nachdem, wie diese beiden Faktoren in einem Material zusammenwirken, kann ein Matrixmaterial als Elektronentransportmaterial oder als Lochtransportmaterial dienen. Dabei findet jeweils auch der Ladungsträgertransport der anderen Ladung statt, es überwiegt jedoch der Transport eines Ladungsträgers. Findet in einem Matrixmaterial kein Ladungsträgertransport statt, wie in einer Ausführungsform der Erfindung in dem ersten Matrixmaterial, so kann das entweder darauf zurückzuführen sein, dass keine Ladungsträger erzeugt werden oder dass keine Mobilität der Ladungsträger vorhanden ist. Neben dem ersten Matrixmaterial können weitere Matrixmaterialien in der organischen, funktionellen Schicht vorhanden sein, die nicht zum Ladungsträgertransport beitragen.

Die Energieniveaus HOMO und LUMO eines Materials können gemessen werden, um geeignete Materialien für erstes, zweites und drittes Matrixmaterial auszuwählen. So kann das HOMO eines Materials mittels Cyclovoltametrie bestimmt werden. Die Bandlücke, also der energetische Unterschied zwischen HOMO und LUMO kann weiterhin mittels Spektroskopie ermittelt werden, bei der die Wellenlänge des emittierten Lichts

gemessen wird und daraus die entstandenen Exzitonen und die Bandlücke berechnet wird. Das Energieniveau des LUMO wird dann aus dem ermittelten HOMO und der Bandlücke berechnet. Das HOMO kann alternativ auch mittels Photoelektronenspektroskopie ermittelt werden.

Die Mobilität von Elektronen und Löchern kann von dem Molekülabstand, also dem mittleren Abstand von Ladungsträgertransportierenden Molekülen in dem jeweiligen Matrixmaterial abhängen. Somit spielt die Konzentration eines Matrixmaterials in der Mischung mehrerer Matrixmaterialien eine Rolle. Das erste Matrixmaterial, das im Vergleich zu dem zweiten und dritten Matrixmaterial die größte Bandlücke und die geringste Ladungsträgermobilität aufweist, kann dazu dienen, die Konzentration des zweiten und des dritten Matrixmaterials getrennt voneinander einzustellen. Je nach der gewählten Konzentration des zweiten und dritten Matrixmaterials ändern sich die Abstände zwischen den jeweiligen Molekülen. Der mikroskopische Ladungsträgertransport hängt vom Molekülabstand der Ladungsträgertransportierenden Moleküle in dem jeweiligen Matrixmaterial ab, sodass sich durch die Einstellung der Konzentration die Mobilität von Elektronen und Löchern in der Matrix, die zumindest drei Matrixmaterialien aufweist, getrennt voneinander absolut einstellen lässt.

Nach Miller und Abraham kann die Mobilität folgendermaßen bestimmt werden:

$$\nu_{ij} = \nu_0 \exp[-2\gamma a(\Delta R_{ij}/a)]$$

In diesem Modell wird ein Festkörper schematisch gesehen aus den Plätzen i und j aufgebaut, auf denen sich die

Ladungsträger befinden können. Jeder Platz repräsentiert einen lokalisierten Zustand. Der Transport eines Ladungsträgers zwischen den Plätzen i und j wird durch einen Widerstand R_{ij} dargestellt. Die Größe des temperaturabhängigen Widerstands spiegelt dabei den räumlichen Abstand zwischen den Plätzen und die benötigte Aktivierungsenergie für den Übergang wider. Der Parameter γ steht für den Abfall der elektronischen Wellenfunktion der Ladungsträger, a ist der Parameter für den durchschnittlichen Gitterabstand. Die Phononenfrequenz ν_0 gibt die Anzahl der Versuche eines Ladungsträgers aus einem lokalisierten Zustand in einen anderen lokalisierten Zustand zu gelangen an, liegt im Bereich von etwa 10^{13} s^{-1} und berücksichtigt die Stärke der Elektronenphononkopplung.

Die elektronische Vorrichtung kann weiterhin eine organische, funktionelle Schicht aufweisen, die aus einer Gruppe ausgewählt ist, die Emissionsschichten, Elektronentransportschichten, Lochtransportschichten, Elektronenblockierschichten, Lochblockierschichten, Lochinjektionsschichten, Elektroneninjektionsschichten und Zwischenschichten umfasst. Mit Zwischenschichten werden Schichten bezeichnet, die zwischen zwei Emissionsschichten angeordnet sind. Je nachdem, was für eine organische, funktionelle Schicht ausgewählt wird, können diese Schichten noch zusätzliche Dotierstoffe enthalten. Die organische, funktionelle Schicht kann eine Emissionsschicht sein und mit zumindest einem Emittermaterial dotiert sein. Emittermaterialien können kleine Moleküle oder Polymere umfassen. Die Konzentration des Emittermaterials in einer Emissionsschicht kann bis zu 10 Gew% betragen. Weiterhin kann das Emittermaterial aufgrund der niedrigen Konzentration in der Emissionsschicht nur eine geringe Ladungsträgermobilität

aufweisen und damit nur geringfügig zum Ladungsträgertransport beitragen.

In der Emissionsschicht können auch zwei oder drei Emittermaterialien vorhanden sein. Die Emittermaterialien können beispielsweise ausgewählt sein aus dem grün emittierenden $Ir(ppy)_3$ (Tris(2-phenylpyridin)iridium(III)), dem rot emittierenden $Ir(piq)_3$ (Tris(1-phenylisoquinolin)iridium(III)) oder dem blau emittierenden Firpic (Bis(3,5-Difluoro-2-(2-pyridyl)phenyl-(2-carboxypyridyl)iridium(III)).

Die Konzentrationen des Emittiermaterials und der Matrixmaterialien in der organischen funktionellen Schicht können innerhalb der organischen funktionellen Schicht einen Gradienten aufweisen. Damit kann beispielsweise die Konzentration des Emittermaterials in einem ersten Teilbereich der Schicht höher sein als in einem zweiten Teilbereich der Schicht.

Durch Verzicht auf die Dotierung mit Emittermaterialien lassen sich Transport-, Zwischen- und Blockierschichten herstellen.

In einer elektronischen Vorrichtung können auch mehrere organische, funktionelle Schichten vorhanden sein, wobei die Schichten unterschiedliche Funktionen oder gleiche Funktionen aufweisen können. Beispielsweise kann eine elektronische Vorrichtung eine Abfolge mehrerer funktioneller, organischer Schichten aufweisen, die beispielsweise zusammengesetzt ist aus einer Lochinjektionsschicht, einer Lochtransportschicht, einer ersten Emissionsschicht, einer Zwischenschicht, einer zweiten Emissionsschicht, einer Elektronentransportschicht

und einer Elektroneninjektionsschicht. Jede dieser Schichten kann eine Matrix aufweisen, die mindestens ein erstes, ein zweites und ein drittes Matrixmaterial aufweist. Die Matrixmaterialien in den verschiedenen organischen funktionellen Schichten können in allen Schichten gleich oder unterschiedlich gewählt werden.

Je nachdem, wo sich die Emissionsschicht in dem Schichtstapel der elektronischen Vorrichtung befindet, kann dort die Mobilität von Elektronen und Löchern innerhalb dieser Schicht getrennt voneinander optimiert werden, wenn die Emissionsschicht ein erstes, ein zweites und ein drittes Matrixmaterial aufweist. Die Mobilität kann auch über mehrere Schichten hinweg optimiert werden.

Auch wenn die Emissionsschicht, die die drei Matrix-materialien aufweist, nahe einer Anode oder einer Kathode liegt, kann die Mobilität von Elektronen und Löchern so eingestellt werden, dass das Verhältnis von Löchern und Elektronen in der Emissionsschicht ausgeglichen ist. Je nachdem, welche Ladungsträgersorte eine höhere Beweglichkeit aufweisen soll, kann die Matrix eine höhere Konzentration des jeweiligen Matrixmaterials enthalten. So kann in der Emissionsschicht, unabhängig von der Lage der Emissionsschicht der elektronischen Vorrichtung, eine hohe Anzahl an Exzitonen gebildet werden.

Wenn die organische, funktionelle Schicht eine Emissionsschicht mit einem Emittermaterial ist, kann das LUMO des Emittermaterials energetisch niedriger als das LUMO des ersten, zweiten und dritten Matrixmaterials sein und das HOMO des Emittermaterials energetisch höher als das HOMO des ersten, zweiten und dritten Matrixmaterials sein. Somit ist

die Bandlücke zwischen HOMO und LUMO des Emittermaterials kleiner als die Bandlücken der drei Matrixmaterialien und liegt zudem energetisch zwischen allen Bandlücken aller Matrixmaterialien. Ein ambipolarer Ladungstransport in einer Emissionsschicht ist somit möglich.

Die Moleküle des zweiten und dritten Matrixmaterials transportieren bevorzugt nur jeweils eine Ladungsträgersorte, Löcher oder Elektronen, somit bilden sich auf ihnen keine Exzitonen. Damit wird die Lebensdauer der Materialien erhöht, da keine Degradation durch Anregungsenergie stattfinden kann. Zwischen den verschiedenen Molekülen der Matrixmaterialien entstehen angeregte Zustände (Eximere), die ihre Anregungsenergie durch Energietransfer auf die Emittermoleküle übertragen können. Somit wird die Effizienz der elektronischen Vorrichtung weiterhin erhöht.

Eine elektronische Vorrichtung kann auch mehrere Emissionsschichten aufweisen, beispielsweise um phosphoreszente und fluoreszente Emittermaterialien in einer Vorrichtung zu kombinieren. Dann kann das Einfügen einer Zwischenschicht zwischen den Emissionsschichten notwendig sein, die beispielsweise ambipolare Ladungstransporteigenschaften aufweisen kann. Dies ist durch die Kombination von drei Matrixmaterialien möglich.

Durch Einstellung der Ladungsträgermobilität mit Hilfe der drei Matrixmaterialien ist es möglich, die Lage der Rekombinationszone in einer Emissionsschicht gezielt zu beeinflussen. Die Rekombinationszone kann sich dabei innerhalb einer Schicht oder über mehrere Schichten verteilt befinden. Durch die Einführung der ersten Matrix, die keinen Ladungstransport aufweist, innerhalb einer Emissionsschicht

sinkt der absolute Wert der Ladungsträgermobilität. Daraus ergibt sich eine Rekombinationszone, die Zone in der Exzitonen gebildet werden, die von den Rändern einer emittierenden Schicht zur Mitte hin verschoben wird. Dies erhöht die Effizienz der Vorrichtung, da unter anderem die nicht strahlende Abregung von Exzitonen (Quenching) vermindert wird und mehr Exzitonen in der eigentlichen Emissionsschicht gebildet werden, statt in den angrenzenden Schichten.

Bei der elektronischen Vorrichtung kann es sich um eine strahlungsemittierende Vorrichtung beispielsweise um eine organische Licht emittierende Vorrichtung handeln. Diese Licht emittierende Vorrichtung kann eine organische, Licht emittierende Diode (OLED) sein. Weiterhin kann die elektronische Vorrichtung eine Solarzelle oder einen Transistor umfassen.

Beispielsweise ist die zumindest eine organische, funktionelle Schicht bei einem Transistor zwischen der ersten und zweiten Elektrode angeordnet. Weiterhin ist eine dritte Elektrode vorhanden. Die Elektroden können aus Gate-, Source- und Drain-Elektrode ausgewählt sein. Ein Transistor kann zum Schalten oder Verstärken von elektrischen Signalen verwendet werden.

Bei einer Solarzelle kann Licht in elektrische Energie umgewandelt werden. Hier ist die organische, funktionelle Schicht zwischen der ersten und der zweiten Elektrode angeordnet, wobei zumindest eine der Elektroden transparent ausgeformt ist.

Die Vorrichtung kann in einer organischen funktionellen Schicht als erstes Matrixmaterial beispielsweise mCP (*m*-Bis(N-carbazolylbenzol)), als zweites Matrixmaterial, das ein Lochtransportmaterial sein kann, TCTA (9H-carbazol,9,9',9''-(1,3,5-Benzoltriyl)tris-(9Cl)), und als drittes Matrixmaterial, das ein Elektronentransportmaterial sein kann, beispielsweise TPBi (1,3,5-Tris(N-Phenylbenzylimidazol-2-yl) aufweisen. Soll eine Matrix für eine Emissionsschicht bereitgestellt werden, kann als Emittermaterial beispielsweise der gelbe Emitter Rubren (5,6,11,12-Tetraphenylnaphthacen) eingefügt werden.

Es wird weiterhin ein Verfahren zur Herstellung einer elektronischen Vorrichtung mit den oben beschriebenen Eigenschaften bereitgestellt. Das Verfahren umfasst die Verfahrensschritte A) Bereitstellen eines Substrats, B) Bereitstellen einer ersten Elektrode und einer zweiten Elektrode, C) Anordnen zumindest einer organischen Schicht zwischen der ersten Elektrode und der zweiten Elektrode Beispielsweise kann die zumindest eine organische, funktionelle Schicht auf der ersten Elektrode und die zweite Elektrode auf der organischen, funktionellen Schicht angeordnet werden. Im Verfahrensschritt C) wird dabei mindestens ein erstes Matrixmaterial, ein zweites Matrixmaterial und ein drittes Matrixmaterial gleichzeitig aufgebracht. Das Aufbringen im Verfahrensschritt C) kann beispielsweise durch Aufdampfen (Koevaporation) geschehen. Durch das gleichzeitige Aufbringen kann die Konzentration des jeweiligen Matrixmaterials unabhängig von den anderen Matrixmaterialien bestimmt werden, sodass die Matrixmaterialien in verschiedenen Konzentrationen aufgebracht werden können.

Anhand der Figuren und Ausführungsbeispiele soll die Erfindung näher erläutert werden:

Figur 1 zeigt die schematische Seitenansicht einer elektronischen Vorrichtung,

Figur 2 zeigt eine schematische Ansicht der energetischen Zustände der verschiedenen Matrixmaterialien,

Figur 3 zeigt eine schematische Seitenansicht einer elektronischen Vorrichtung,

Figur 4 zeigt die Simulation der Mobilität der Ladungsträger in einer Emissionsschicht,

Figur 5 zeigt den schematischen Aufbau zur Herstellung einer Schicht mit mehreren Matrixmaterialien.

Figur 1 zeigt die schematische Seitenansicht einer elektronischen Vorrichtung, die ein Substrat 10, eine erste Elektrode 20, eine Emissionsschicht 30 und eine zweite Elektrode 40 umfasst. Die erste Elektrode kann beispielsweise eine Anode und die zweite Elektrode eine Kathode sein. Je nachdem, ob das Substrat und die erste Elektrode oder die zweite Elektrode transparent ausgeformt sind, kann es sich bei der elektronischen Vorrichtung um eine Bottom-emittierende oder eine Top-emittierende Vorrichtung, beispielsweise eine OLED, handeln. Die Emissionsschicht 30 kann ein erstes, ein zweites und ein drittes Matrixmaterial aufweisen und mit einem Emittermaterial dotiert sein.

Figur 2 zeigt die schematische Darstellung der Energieniveaus der jeweiligen Materialien in der Emissionsschicht in einer

beispielhaften Ausführungsform. Es ist das HOMO und LUMO des ersten Matrixmaterials 30N, des zweiten Matrixmaterials 30B und des dritten Matrixmaterials 30A gezeigt. Das erste Matrixmaterial weist ein HOMO auf, das energetisch niedriger liegt als das HOMO des zweiten Matrixmaterials und des dritten Matrixmaterials. Weiterhin weist das erste Matrixmaterial ein LUMO auf, das energetisch höher liegt als das LUMO des zweiten Matrixmaterials und des dritten Matrixmaterials. Das zweite Matrixmaterial weist ein LUMO auf, das energetisch höher liegt als das LUMO des dritten Matrixmaterials und ein HOMO, das energetisch höher liegt als das HOMO des dritten Matrixmaterials. Damit weist das erste Matrixmaterial geringere Ladungsträgermobilitäten als die beiden anderen Matrixmaterialien auf, das zweite Matrixmaterial kann ein Lochtransportmaterial und das dritte Matrixmaterial ein Elektronentransportmaterial umfassen.

Das Emittermaterial 30E weist ein HOMO und LUMO auf, das die geringste Bandlücke im Vergleich zu den Matrixmaterialien hat und zwischen den LUMOs und den HOMOs der drei Matrixmaterialien liegt.

Rechts in dem Schema ist die Summe der verschiedenen Energieniveaus aufgezeigt. A symbolisiert das Energieniveau, bei dem der Elektronentransport stattfindet, B symbolisiert das Energieniveau, bei dem Lochtransport stattfindet. d1 und d2 stehen für die energetischen Abstände zwischen den LUMOs des ersten und zweiten Matrixmaterials (d1) und den HOMOs des ersten und dritten Matrixmaterials (d2). d3 symbolisiert die Bandlücke des Emittermaterials. Wird kein Emittermaterial eingesetzt, kann es sich bei der Schicht auch um eine Ladungsträgertransport-, Ladungsträgerinjektions- oder Ladungsträgerblockierschicht handeln. Weiterhin können auch

mehrere Emittermaterialien eingesetzt werden. Das Emittermaterial weist in der Emissionsschicht eine Konzentration von ≤ 10 Gew% auf.

Figur 3 zeigt die schematische Seitenansicht einer weiteren Ausführungsform der elektronischen Vorrichtung, die eine Emissionsschicht 30 aufweist, an die jeweils auf einer Seite eine Elektronentransportschicht 32 und eine Lochtransportschicht 31 angrenzt. Hier handelt es sich bei der ersten Elektrode 20 um eine Anode.
Sowohl die Emissionsschicht 30 als auch die Elektronentransportschicht 32 und die Lochtransportschicht 31 können Matrizen aufweisen, die sich aus drei oder mehr Matrixmaterialien zusammensetzen.

Figur 4 zeigt die Simulation des Ladungsträgertransports in einer OLED, in der eine Emissionsschicht, eine Lochtransportschicht 31 und eine Elektronentransportschicht 32 vorhanden ist. Die x-Achse zeigt die Entfernung der jeweiligen Schicht von der Anode D [nm], die y-Achse zeigt die normierte Rekombinationsrate R_n. Man kann sehen, dass mit Verringerung des absoluten Wertes der Ladungsträgermobilität in der Emissionsschicht 30 im Vergleich zu der Lochtransportschicht 31 und der Elektronentransportschicht 32 die Rekombinationszone von den Rändern der Emissionsschicht zur Mitte hin verschoben wird. Das heißt, mit sinkender Mobilität der Ladungsträger in der Emissionsschicht 30 verringert sich die Rekombination in den angrenzenden Schichten 32 und 31 und verschiebt sich zur Mitte der Emissionsschicht 30.

Bei der Simulation wurden Elektronen- und Lochmobilität in der Emissionsschicht gleichgesetzt, also ein ambipolarer Ladungstransport angenommen. Es wurde ohmsche Injektion

angenommen, alle Energiebarrieren zwischen HOMO und LUMO der zwei Schichten betrugen 400 meV für die jeweilige Ladungsträgersorte. In dem Diagramm sind für die verschiedenen Linienformen die jeweiligen Mobilitäten der Ladungsträger in m^2/Vs angegeben, sie bewegen sich zwischen 10^{-8} bis zu 10^{-12}.

Figur 5 zeigt die schematische Seitenansicht eines Aufbaus zur Herstellung der elektronischen Vorrichtung. Auf einer Halterung 51 sind beispielhaft vier Verdampfungsquellen 50 aufgebracht, aus denen jeweils Matrixmaterialien und/oder Dotierstoffe auf das Abscheidesubstrat 60 aufgedampft werden können. Um die jeweilige Konzentration des Matrixmaterials und/oder des Dotierstoffs genau bestimmen zu können, wird die Verdampfungsrate über Schichtdickenmonitore 55 gemessen und eingestellt. Bei den Schichtdickenmonitoren kann es sich beispielsweise um Schwingquarze handeln.

Beispielsweise kann mit einem Aufbau gemäß Figur 5 eine Emissionsschicht hergestellt werden, die ein erstes Matrixmaterial enthält, das mCP (*m*-Bis(N-carbazolylbenzol)) umfasst und mit einer Aufdampfrate von 3,8 Å/s aufgebracht wird. Das zweite Matrixmaterial, das Lochtransportmaterial kann TCTA (9H-carbazol,9,9',9''-(1,3,5-Benzoltriyl)tris-(9Cl)) sein und mit einer Aufdampfrate von 8 Å/S aufgebracht werden. Das dritte Matrixmaterial, das Elektronen-transportmaterial, kann beispielsweise TPBi (1,3,5-Tris(N-Phenylbenzylimidazol-2-yl) sein und mit einer Aufdampfrate von 8 Å/S aufgebracht werden. Als Emittermaterial kann beispielsweise der gelbe Emitter Rubren (5,6,11,12-Tetraphenylnaphthacen) eingebracht werden und mit einer Aufdampfrate von 0,2 Å/S aufgebracht werden. Damit ergibt sich eine Schicht mit einer Volumenkonzentration von 40% für

die Ladungsträgertransportmaterialien und 1% für den Emitter. In Tabelle 1 sind die HOMOs und LUMOs dieser Materialien angegeben. Die Werte der HOMOs von TCTA, TPBi, mCP wurden mittels UV-Photoemissionsspektroskopie bestimmt, die korrespondierenden LUMO-Werte wurden abgeschätzt, indem die für die Absorption benötigte Energie zu dem HOMO-Wert dazugezählt wurde. Der HOMO- und LUMO-Wert von Rubren wurde mittels Cyclovoltammetrie und Photoelektronenspetrometrie bestimmt.

	HOMO [eV]	LUMO [eV]
mCP	-5,9	-2,4
TCTA	-5,7	-2,3
TPBi	-6,3	-2,8
Rubren	-5,5	-3,0

Tabelle 1

Das dritte Matrixmaterial TPBi weist den im Vergleich mit den anderen Matrixmaterialien niedrigsten Wert für das LUMO auf und ist somit Elektronentransportmaterial. Das zweite Matrixmaterial TCTA weist den im Vergleich mit den anderen Matrixmaterialien größten Wert für das HOMO auf und ist somit Lochtransportmaterial. Das erste Matrixmaterial mCP ist nicht am Ladungsträgertransport beteiligt, da sein LUMO nicht niedriger als das LUMO des dritten Matrixmaterials ist und sein HOMO nicht höher als das HOMO des zweiten Matrixmaterials ist.

Weitere mögliche Lochtransportmaterialien sind:

NPB	N,N'-Bis(Naphthalen-1-yl)-N,N'-bis(phenyl)-Benzidin
TCTA	4,4',4''-Tris(carbazol-9-yl)triphenylamin
CPB	4,4'-Bis(carbazol-9-yl)biphenyl
1T-NATA	4,4',4''-Tris(N-(1-naphthyl)-N-phenyl-

amino)triphenylamin

Spiro-TAD 2,2',7,7'-Tetrakis(N,N-diphenylamino)-9,9'-spirobifluoren

Als Elektronentransportmaterialien können weiterhin eingesetzt werden:

TPBi 2,2',2''-(1,3,5-Benzintriyl)-tris(1-phenyl-1-H-benzimidazol)

TAZ 3-(4-Biphenylyl)-4-Phenyl-5-tert-butylphenyl-1,2,4-triazol

Alq_3 Tris(8-Hydroxy-quinolinato)aluminium

BCP 2,9-Dimethyl-4,7-diphenyl-1,10-phenanthrolin

NTAZ 4-(Naphthalen-1-yl)-3,5-diphenyl-4H-1,2,4-triazol

Balq Bis-(2-methyl-8-quinolinolat)-4-(phenylphenolato)aluminium

Als erstes Matrixmaterial, das im Vergleich zu den anderen Matrixmaterialien die geringste Ladungsträgermobilität aufweist, kann eingesetzt werden:

UGH-2 1,4-Bis(triphenylsilyl)benzol

UGH-3 1,3-Bis(triphenylsilyl)benzol

mCP 1,3-Bis(carbazol-9-Yl)benzol

Die HOMOs von UGH-2 und UGH-3 haben Werte von -7,2 ± 0,1 eV, die LUMOs liegen bei 2,8 eV. Diese HOMO-Werte können mittels Photoelektronenspektroskopie bestimmt werden, die LUMO-Werte können aus dem Abstand von HOMO-Werten und LUMO-Werten am Schnittpunkt des Absorptions- und des Fluoreszenzspektrums abgeschätzt werden.

Mögliche Emittermaterialien sind:

$Ir(ppy)_3$ Tris(2-phenylpyridin)iridum(III)

$Ir(ppy)_2(acac)$	Bis(2-phenylpyridlin)(acetylacetonat)iridium(II)
BczVBi	4,4'-Bis(9-ethyl-3-carbazovinylen)-1,1'-biphenyl
FirPic	Bis(3,5-Difluoro-2-(2-pyridyl)phenyl-(2-carboxy-pyridyl)iridium(III)
Rubren	Tetraphenylnaphthacen
$Ir(piq)_3$	Tris(1-phenylisoquinolin)iridium(III)

Bei diesen Emittermaterialien handelt es sich um kleine, nicht-polymere Moleküle. Der Einsatz von polymeren Emittermaterialien ist ebenso möglich.

Weitere mögliche Materialien, die je nach Lage ihrer HOMOs und LUMOs zueinander als erste, zweite oder dritte Matrix eingesetzt werden können, sind:

Bphen	4,7-Diphenyl-1,10-phenanthrolin
DPAVBi	4,4'-Bis(2-(4-(N,N-diphenylamino)phenyl)vinyl)biphenyl
CuPC	Phthalocyanin Kupfer Komplex
S-DPVBi	2,2',7,7'-Tetrakis(2,2-diphenylvinyl)spiro-9,9'-bifluorenCPF
TAPC	1,1-Bis-(4-bis(4-methylphenyl)-aminophenyl)-cyclohexan
TBADN	9,10-Bis(2-naphthyl)-2-t-butylanthracen
TPD	N,N,N',N'-Tetraphenylbenzidin

Einige der Elektronen- und Lochtransportmaterialien können auch als erstes Matrixmaterial dienen. Wichtig bei der Zusammenstellung des ersten, zweiten und dritten Matrixmaterials für die Matrix sind das relative Verhältnis der LUMOs und HOMOs der drei kombinierten Materialien und deren Lage zueinander.

Die Matrix kann für phosphoreszente Emitter aufgrund der chemischen Verträglichkeit nicht beliebig gewählt werden. Der rote Emitter Iridium (III)bis(2-methyldibenzo-[f,h]quinoxalin)-acetylacetonat) ist nur in einer NBP-Matrix effizient. NPB ist jedoch ein Lochtransportmaterial. Befindet sich nun anodenseitig noch eine weitere Emitterschicht, wird diese nicht ausreichend mit Elektronen versorgt. Durch Eindotierung eines Elektronentransportmaterials, beispielsweise BCP, können die relativen Transporteigenschaften eingestellt werden. Die Feinabstimmung der Transporteigenschaften erfolgt mit UGH4.

Die in den Figuren und Ausführungsbeispielen gezeigten Ausführungsformen können beliebig variiert werden. Es ist weiterhin zu berücksichtigen, dass sich die Erfindung nicht auf die Beispiele beschränkt, sondern weitere, hier nicht aufgeführte Ausgestaltungen zulässt.

Patentansprüche

1. Elektronische Vorrichtung, umfassend
   - ein Substrat,
   - eine erste Elektrode,
   - zumindest eine organische, funktionelle Schicht, und
   - eine zweite Elektrode, wobei die zumindest eine organische, funktionelle Schicht zwischen der ersten Elektrode und der zweiten Elektrode angeordnet ist und wobei die zumindest eine organische, funktionelle Schicht mindestens ein erstes Matrixmaterial, ein zweites Matrixmaterial und ein drittes Matrixmaterial aufweist und das dritte Matrixmaterial ein Lowest Unoccupied Molecular Orbital (LUMO), das energetisch niedriger als das LUMO des zweiten Matrixmaterials und das LUMO des ersten Matrixmaterials ist, und wobei das zweite Matrixmaterial ein Highest Occupied Molecular Orbital (HOMO), das energetisch höher als das HOMO des ersten Matrixmaterials und das HOMO des dritten Matrixmaterials ist, aufweist.

2. Elektronische Vorrichtung nach dem vorhergehenden Anspruch, wobei das erste Matrixmaterial ein LUMO, das energetisch höher als das LUMO des zweiten Matrixmaterial und das LUMO des dritten Matrixmaterials ist, und ein HOMO, das energetisch niedriger als das HOMO des zweiten Matrixmaterials und das HOMO des dritten Matrixmaterials ist, aufweist.

3. Elektronische Vorrichtung nach dem vorhergehenden Anspruch, wobei das zweite Matrixmaterial ein LUMO, das energetisch höher als das LUMO des dritten

Matrixmaterials ist, und ein HOMO, das energetisch höher als das HOMO des dritten Matrixmaterials ist, aufweist.

4. Elektronische Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das erste Matrixmaterial eine Ladungsträgermobilität aufweist, die geringer ist als die Ladungsträgermobilitäten des zweiten und dritten Matrixmaterials.

5. Elektronische Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das zweite Matrixmaterial ein Lochtransportmaterial umfasst.

6. Elektronische Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das dritte Matrixmaterial ein Elektronentransportmaterial umfasst.

7. Elektronische Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die organische, funktionelle Schicht ausgewählt ist aus einer Gruppe, die Emissionsschichten, Elektronentransportschichten, Lochtransportschichten, Elektronenblockierschichten, Lochblockierschichten, Lochinjektionsschichten, Elektroneninjektionsschichten und Zwischenschichten umfasst.

8. Elektronische Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die organische, funktionelle Schicht eine Emissionsschicht ist und mit zumindest einem Emittermaterial dotiert ist.

9. Elektronische Vorrichtung nach dem vorhergehenden Anspruch, wobei das Emittermaterial in der

Emissionsschicht eine Konzentration von ≤ 10 Gew% aufweist.

10. Elektronische Vorrichtung nach dem vorhergehenden Anspruch, wobei die Konzentration des Emittermaterials in der Emissionsschicht einen Gradienten aufweist.

11. Elektronische Vorrichtung nach einem der Ansprüche 8 bis 10, wobei das LUMO des Emittermaterials energetisch niedriger als das LUMO des ersten, zweiten und dritten Matrixmaterials ist und das HOMO des Emittermaterials energetisch höher als das HOMO des ersten, zweiten und dritten Matrixmaterials ist.

12. Elektronische Vorrichtung nach einem der vorhergehenden Ansprüche, die als strahlungsemittierende Vorrichtung ausgebildet ist.

13. Elektronische Vorrichtung nach einem der Ansprüche 1 bis 11, wobei die Vorrichtung ausgewählt ist aus einer Gruppe, die eine organische Licht emittierende Vorrichtung, eine Solarzelle und einen Transistor umfasst.

14. Verfahren zur Herstellung einer elektronischen Vorrichtung gemäß den Ansprüchen 1 bis 13, mit den Verfahrensschritten

A) Bereitstellen eines Substrats,

B) Bereitstellen einer ersten Elektrode und einer zweiten Elektrode,

C) Anordnen zumindest einer organischen, funktionellen Schicht zwischen der ersten Elektrode und der zweiten Elektrode

wobei im Verfahrensschritt C) mindestens das erste Matrixmaterial, das zweite Matrixmaterial und das dritte Matrixmaterial gleichzeitig aufgebracht werden.

15. Verfahren nach dem vorhergehenden Anspruch, wobei im Verfahrensschritt C) das erste Matrixmaterial, das zweite Matrixmaterial und das dritte Matrixmaterial durch Aufdampfen aufgebracht werden.

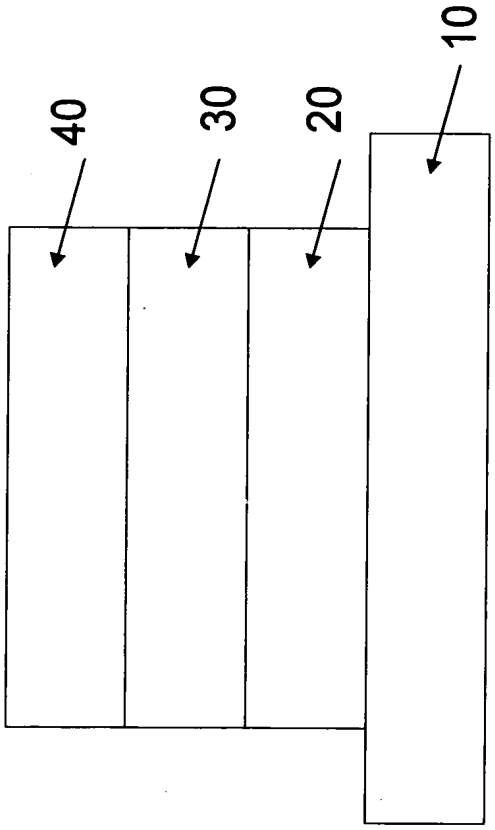


Fig. 1

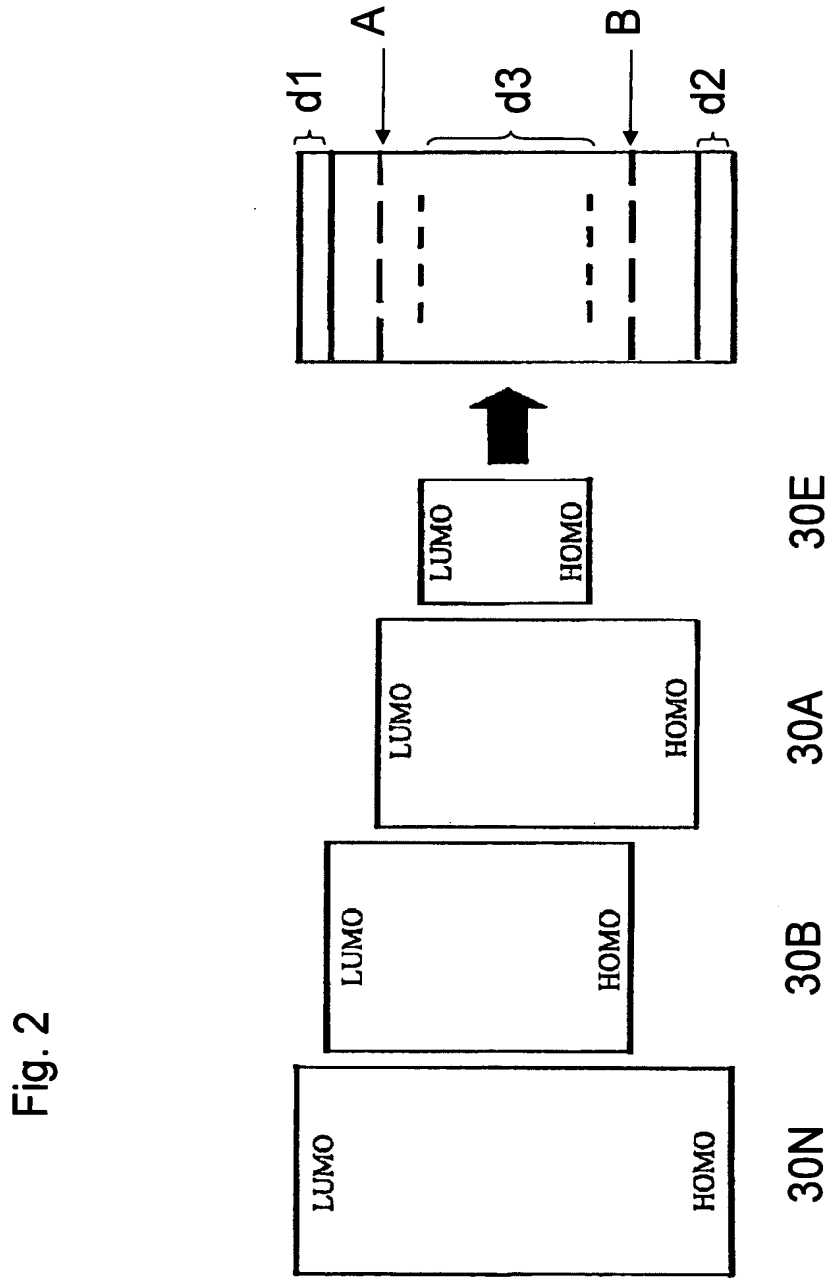


Fig. 2

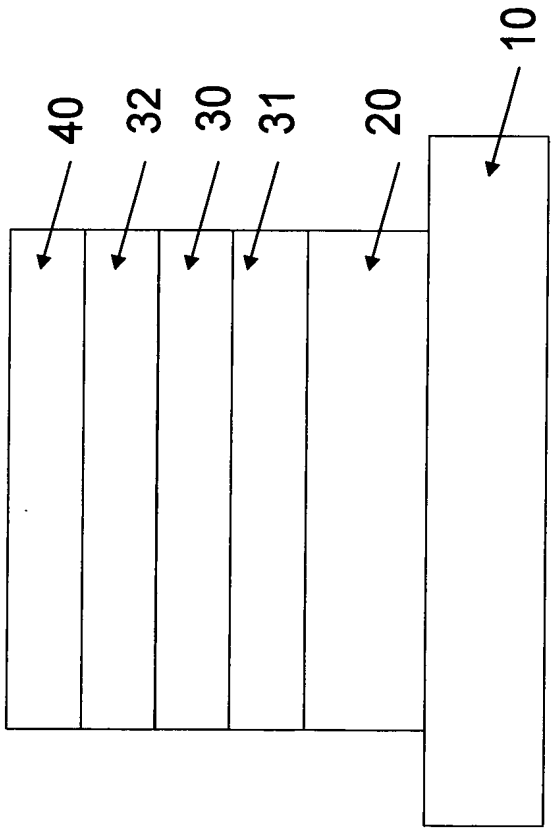


Fig. 3

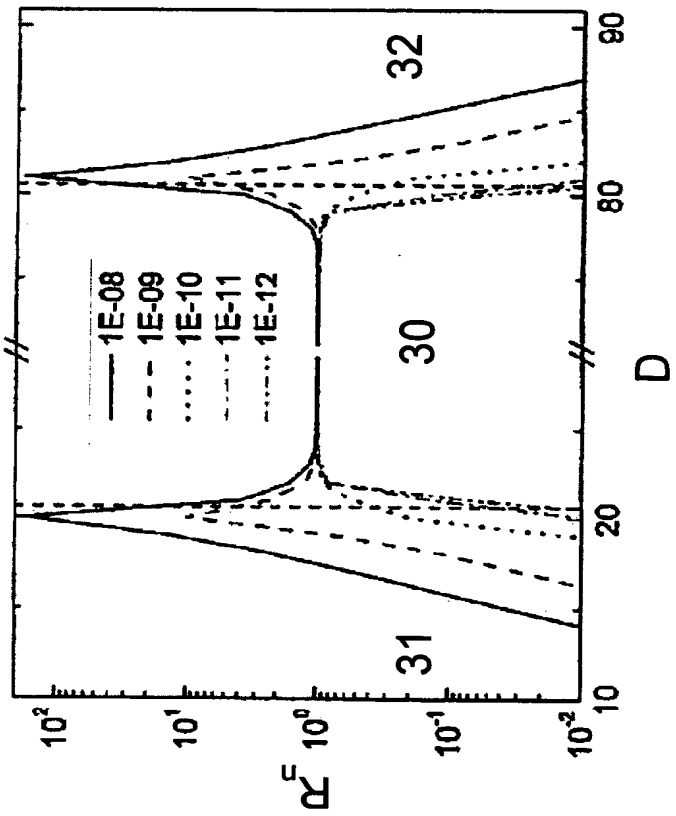

32
30
31
1E-08
1E-09
1E-10
1E-11
1E-12
D
R^C
10^2
10^1
10^0
10^{-1}
10^{-2}
10
20
80
90

Fig. 4

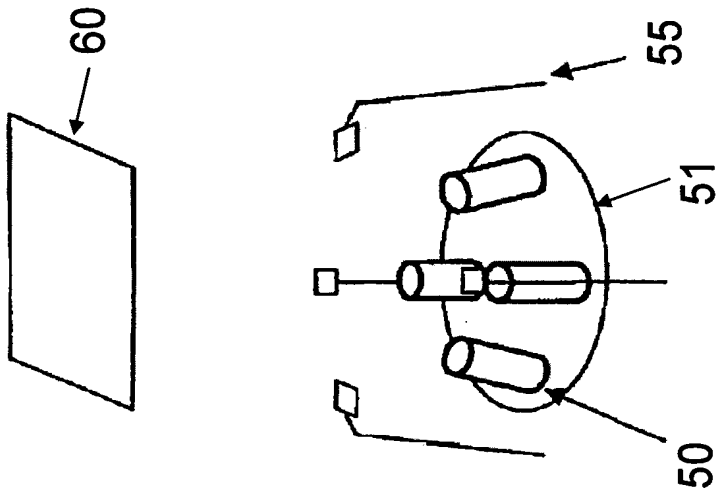


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/DE2009/000701

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01L51/50

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01L H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/116536 A1 (FORREST STEPHEN R [US]; YANG FAN [US]) 22 May 2008 (2008-05-22) paragraphs [0081] - [0083], [0126]; figures 9a-h,19	1,3,6,7, 12,13
A	US 2002/101154 A1 (SEO SATOSHI [JP]; YAMAZAKI SHUNPEI [JP]) 1 August 2002 (2002-08-01) paragraphs [0044] - [0056], [0090] - [0094]; figures 4b,7b	1-15
A	US 2006/068223 A1 (NARIYUKI FUMITO [JP]; YAMAZAKI KAZUKI [JP]) 30 March 2006 (2006-03-30) paragraphs [0028], [0029]	1-15

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
23 September 2009	05/10/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Bakos, Tamás

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INTERNATIONAL SEARCH REPORT

International application No
PCT/DE2009/000701

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 02/074015 A (UNIV PRINCETON [US]; UNIV SOUTHERN CALIFORNIA [US]; THOMPSON MARK E [) 19 September 2002 (2002-09-19) page 14, line 7 - page 15, line 1 page 16, line 8 - page 19, line 1; figures 1,4	1-15
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/DE2009/000701

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		CN 101159318 A	09-04-2008
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		TW 520614 B	11-02-2003
		US 2009096369 A1	16-04-2009
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		CN 1535483 A	06-10-2004
		EP 1374320 A2	02-01-2004
		JP 2004526284 T	26-08-2004
		TW 540252 B	01-07-2003
US 2008074038 A1	27-03-2008	KR 20080028212 A	31-03-2008

INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
PCT/DE2009/000701

A. KLASSIFIZIERUNG DES ANMELDUNGSGEGENSTANDES
INV. H01L51/50

Nach der Internationalen Patentklassifikation (IPC) oder nach der nationalen Klassifikation und der IPC

B. RECHERCHIERTE GEBIETE

Recherchierter Mindestprüfstoff (Klassifikationssystem und Klassifikationssymbole)
H01L H05B

Recherchierte, aber nicht zum Mindestprüfstoff gehörende Veröffentlichungen, soweit diese unter die recherchierten Gebiete fallen

Während der internationalen Recherche konsultierte elektronische Datenbank (Name der Datenbank und evtl. verwendete Suchbegriffe)
EPO-Internal

C. ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
X	US 2008/116536 A1 (FORREST STEPHEN R [US]; YANG FAN [US]) 22. Mai 2008 (2008-05-22) Absätze [0081] - [0083], [0126]; Abbildungen 9a-h,19	1,3,6,7, 12,13
A	US 2002/101154 A1 (SEO SATOSHI [JP]; YAMAZAKI SHUNPEI [JP]) 1. August 2002 (2002-08-01) Absätze [0044] - [0056], [0090] - [0094]; Abbildungen 4b,7b	1-15
A	US 2006/068223 A1 (NARIYUKI FUMITO [JP]; YAMAZAKI KAZUKI [JP]) 30. März 2006 (2006-03-30) Absätze [0028], [0029]	1-15

-/--

[X] Weitere Veröffentlichungen sind der Fortsetzung von Feld C zu entnehmen [X] Siehe Anhang Patentfamilie

* Besondere Kategorien von angegebenen Veröffentlichungen :
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Datum des Abschlusses der internationalen Recherche	Absendedatum des internationalen Recherchenberichts
23. September 2009	05/10/2009

Name und Postanschrift der Internationalen Recherchenbehörde	Bevollmächtigter Bediensteter
Europäisches Patentamt, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Bakos, Tamás

SDC EX. 1002 - 104/325

INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
PCT/DE2009/000701

C. (Fortsetzung) ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
A	WO 02/074015 A (UNIV PRINCETON [US]; UNIV SOUTHERN CALIFORNIA [US]; THOMPSON MARK E [) 19. September 2002 (2002-09-19) Seite 14, Zeile 7 - Seite 15, Zeile 1 Seite 16, Zeile 8 - Seite 19, Zeile 1; Abbildungen 1,4	1-15
A	US 2008/074038 A1 (KIM HEE-KYUNG [KR]; TAMURA SHINICHIRO [KR]; RAGINI DAS RUPASREE [KR];) 27. März 2008 (2008-03-27) Absätze [0066] - [0088]; Abbildung 3; Tabelle 2	1-15

Formblatt PCT/ISA/210 (Fortsetzung von Blatt 2) (April 2005)

INTERNATIONALER RECHERCHENBERICHT

Angaben zu Veröffentlichungen, die zur selben Patentfamilie gehören

Internationales Aktenzeichen
PCT/DE2009/000701

Im Recherchenbericht angeführtes Patentdokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie	Datum der Veröffentlichung
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		EP 1374320 A2	02-01-2004
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		TW 540252 B	01-07-2003
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Document made available under the Patent Cooperation Treaty (PCT)

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Document type: Certified copy of priority document

Document details: Country/Office: DE
Number: 10 2008 039 361.4
Filing date: 22 August 2008 (22.08.2008)

Date of receipt at the International Bureau: 16 September 2009 (16.09.2009)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)

World Intellectual Property Organization (WIPO) - Geneva, Switzerland
Organisation Mondiale de la Propriété Intellectuelle (OMPI) - Genève, Suisse

BUNDESREPUBLIK DEUTSCHLAND

Prioritätsbescheinigung
DE 10 2008 039 361.4
über die Einreichung einer Patentanmeldung

Aktenzeichen:	10 2008 039 361.4
Anmeldetag:	22. August 2008
Anmelder/Inhaber:	OSRAM Opto Semiconductors GmbH, 93055 Regensburg/DE
Bezeichnung:	Elektronische Vorrichtung
Priorität:	30. Mai 2008 DE 10 2008 025 920.9
IPC:	H 01 L 51/46, H 01 L 51/48

Die angehefteten Stücke sind eine richtige und genaue Wiedergabe der Teile der am 22. August 2008 eingereichten Unterlagen dieser Patentanmeldung unabhängig von gegebenenfalls durch das Kopierverfahren bedingten Farbabweichungen.

München, den 9. September 2009
Deutsches Patent- und Markenamt
Die Präsidentin
Im Auftrag

Niggebaum

Beschreibung

Elektronische Vorrichtung

Die Erfindung betrifft eine Elektronische Vorrichtung und ein Verfahren zur Herstellung einer elektronischen Vorrichtung.

Elektronische Vorrichtungen, wie beispielsweise organische Leuchtdioden (OLEDs), bestehen aus einer Abfolge mehrerer funktioneller organischer Schichten. Emissionsschichten weisen dabei ein Matrixmaterial auf, welches mit Emittermolekülen dotiert wird. In der Emissionsschicht werden Exzitonen durch Rekombination von Elektronen und „Löchern" gebildet, die zur Lichtemission führen. Um eine hohe Effizienz der elektronischen Vorrichtung zu erhalten, ist das Verhältnis zwischen Elektronen und „Löchern", die in der Emissionsschicht transportiert werden, entscheidend. Ein nicht ausgeglichenes Verhältnis zwischen Loch- und Elektronentransport resultiert in einer geringen Strahlungseffizienz der Vorrichtung.

Aufgabe der Erfindung ist es, eine elektronische Vorrichtung bereitzustellen, die einen verbesserten Ladungsträgertransport und eine verbesserte Ladungsträger-balance in den organischen Schichten und damit eine erhöhte Effizienz aufweist. Eine weitere Aufgabe der Erfindung ist es, ein Verfahren zur Herstellung einer elektronischen Vorrichtung bereitzustellen. Diese Aufgaben werden durch eine elektronische Vorrichtung gemäß Anspruch 1 und einem Verfahren zur Herstellung der elektronischen Vorrichtung gemäß Anspruch 12 gelöst. Weitere Ausführungsformen der Vorrichtung und des Verfahrens sind Gegenstand weiterer Ansprüche.

Gemäß einer Ausführungsform wird eine elektronische Vorrichtung bereitgestellt, die ein Substrat, eine erste Elektrode, zumindest eine organische, funktionelle Schicht und eine zweite Elektrode umfasst, wobei die zumindest eine organische funktionelle Schicht zwischen der ersten Elektrode und der zweiten Elektrode angeordnet ist. Beispielsweise kann die erste Elektrode auf dem Substrat, die zumindest eine organische funktionelle Schicht auf der ersten Elektrode und die zweite Elektrode auf der zumindest einen organischen, funktionellen Schicht angeordnet sein. Die zumindest eine organische, funktionelle Schicht weist mindestens ein erstes Matrixmaterial, ein zweites Matrixmaterial und ein drittes Matrixmaterial auf, wobei das dritte Matrixmaterial ein Lowest Unoccupied Molecular Orbital (LUMO), das energetisch niedriger als das LUMO des zweiten Matrixmaterials und das LUMO des ersten Matrixmaterials ist, und wobei das zweite Matrixmaterial ein Highest Occupied Molecular Orbital (HOMO), das energetisch höher als das HOMO des ersten Matrixmaterials und das HOMO des dritten Matrixmaterials ist. Damit wird eine elektronische Vorrichtung bereitgestellt, die mehr als zwei verschiedene Matrixmaterialien in einer organischen funktionellen Schicht umfasst. Dabei können drei verschiedene Matrixmaterialien vorhanden sein, je nach Bedarf auch mehr als drei.

Nach der Molekülorbitaltheorie sind in einem Molekül verschiedene Molekülorbitale mit verschiedenen Energieniveaus vorhanden, die von den vorhandenen Elektronen besetzt werden können. Diese Molekülorbitale werden nach zunehmendem Energieniveau besetzt. Das LUMO ist das energetisch niedrigste Molekülorbital, das nicht mehr mit einem Elektron besetzt ist. Das HOMO ist das energetisch am höchsten

gelegene Molekülorbital, das noch mit einem Elektron besetzt ist.

Diese elektronische Vorrichtung weist einen verbesserten Ladungsträgertransport und eine verbesserte Ladungsträgerbalance in der organischen funktionellen Schicht auf, und ein anpassbares Verhältnis zwischen Loch- und Elektronentransport. Das erste Matrixmaterial ist dabei so gewählt, dass es eine große Bandlücke, also die Differenz zwischen HOMO und LUMO aufweist, beispielsweise so dass sein HOMO energetisch unter dem HOMO der anderen beiden Matrixmaterialien und sein LUMO energetisch über dem LUMO der anderen beiden Matrixmaterialien liegt.

Weiterhin kann das erste Matrixmaterial ein LUMO aufweisen, das energetisch höher als das LUMO des zweiten Matrixmaterials und das LUMO des dritten Matrixmaterials ist, und ein HOMO, das energetisch niedriger als das HOMO des zweiten Matrixmaterials und das HOMO des dritten Matrixmaterials ist.

Weiterhin kann in der elektronischen Vorrichtung das zweite Matrixmaterial ein LUMO, das energetisch höher als das LUMO des dritten Matrixmaterials ist, und ein HOMO, das energetisch höher als das HOMO des dritten Matrixmaterials ist, aufweisen. Damit kann das erste Matrixmaterial die größte Bandlücke zwischen HOMO und LUMO im Vergleich zum zweiten und zum dritten Matrixmaterial aufweisen und das zweite Matrixmaterial weist eine Bandlücke auf, die zu der Bandlücke des dritten Matrixmaterials energetisch verschoben ist. Damit können auf dem LUMO des dritten Matrixmaterials Elektronen transportiert werden, und auf dem HOMO des zweiten Matrixmaterials Löcher transportiert werden, da diese

Energieniveaus jeweils am energetisch günstigsten für den jeweiligen Ladungstransport sind.

Das erste Matrixmaterial kann in der elektronischen Vorrichtung eine Ladungsträgermobilität aufweisen, die geringer ist als die Ladungsträgermobilität des zweiten und des dritten Matrixmaterials. Das erste Matrixmaterial kann ein Ultra Wide Band Gap (UGH)-Material sein, welches eine im Vergleich zu den übrigen Matrixmaterialien große Bandlücke aufweist. Dadurch kann es keinen Anteil am Ladungsträgertransport aufweisen.

Das zweite Matrixmaterial kann weiterhin ein Lochtransportmaterial umfassen und das dritte Matrixmaterial kann ein Elektronentransportmaterial umfassen.

Der Ladungsträgertransport, also der Lochtransport und der Elektronentransport, hängt insbesondere von der Mobilität der Löcher beziehungsweise der Elektronen in einem Material und von der Lage der Energieniveaus HOMO und LUMO der Matrixmaterialien ab. Das HOMO und LUMO eines Materials ist dabei für die Ladungsträgerinjektion verantwortlich.

Zur Erzeugung eines Lochs in der Matrix, die sich aus den drei Matrixmaterialien zusammensetzt, muss beispielsweise ein Elektron aus dem HOMO entfernt werden, was bei einem energetisch tief liegenden HOMO schwieriger ist als bei einem energetisch höher liegenden. Somit ist das zweite Matrixmaterial, das ein höher gelegenes HOMO als das dritte Matrixmaterial aufweist, besser als Lochtransportmaterial geeignet, als das dritte Matrixmaterial. Analoges gilt für die Erzeugung von Elektronen in LUMOs, die bei energetisch tiefer gelegenen LUMOs energetisch begünstigt ist. Somit

eignet sich das dritte Matrixmaterial, das ein niedrigeres LUMO als das zweite Matrixmaterial aufweist, als Elektronentransportmaterial.

Sind Löcher und Elektronen erzeugt, spielt weiterhin die Mobilität dieser Ladungsträger in dem Material eine Rolle. Je nachdem, wie diese beiden Faktoren in einem Material zusammenwirken, kann ein Matrixmaterial als Elektronentransportmaterial oder als Lochtransportmaterial dienen. Dabei findet jeweils auch der Ladungsträgertransport der anderen Ladung statt, es überwiegt jedoch der Transport eines Ladungsträgers. Findet in einem Matrixmaterial kein Ladungsträgertransport statt, wie in einer Ausführungsform der Erfindung in dem ersten Matrixmaterial, so kann das entweder darauf zurückzuführen sein, dass keine Ladungsträger erzeugt werden oder dass keine Mobilität der Ladungsträger vorhanden ist. Neben dem ersten Matrixmaterial können weitere Matrixmaterialien in der organischen, funktionellen Schicht vorhanden sein, die nicht zum Ladungsträgertransport beitragen.

Die Energieniveaus HOMO und LUMO eines Materials können gemessen werden, um geeignete Materialien für erstes, zweites und drittes Matrixmaterial auszuwählen. So kann das HOMO eines Materials mittels Cyclovoltametrie bestimmt werden. Die Bandlücke, also der energetische Unterschied zwischen HOMO und LUMO kann weiterhin mittels Spektroskopie ermittelt werden, bei der die Wellenlänge des emittierten Lichts gemessen wird und daraus die entstandenen Exzitonen und die Bandlücke berechnet wird. Das Energieniveau des LUMO wird dann aus dem ermittelten HOMO und der Bandlücke berechnet. Das HOMO kann alternativ auch mittels Photoelektronenspektroskopie ermittelt werden.

Die Mobilität von Elektronen und Löchern kann von dem Molekülabstand, also dem mittleren Abstand von Ladungsträgertransportierenden Molekülen in dem jeweiligen Matrixmaterial abhängen. Somit spielt die Konzentration eines Matrixmaterials in der Mischung mehrerer Matrixmaterialien eine Rolle. Das erste Matrixmaterial, das im Vergleich zu dem zweiten und dritten Matrixmaterial die größte Bandlücke und die geringste Ladungsträgermobilität aufweist, kann dazu dienen, die Konzentration des zweiten und des dritten Matrixmaterials getrennt voneinander einzustellen. Je nach der gewählten Konzentration des zweiten und dritten Matrixmaterials ändern sich die Abstände zwischen den jeweiligen Molekülen. Der mikroskopische Ladungsträgertransport hängt vom Molekülabstand der Ladungsträgertransportierenden Moleküle in dem jeweiligen Matrixmaterial ab, sodass sich durch die Einstellung der Konzentration die Mobilität von Elektronen und Löchern in der Matrix, die zumindest drei Matrixmaterialien aufweist, getrennt voneinander absolut einstellen lässt.

Nach Miller und Abraham kann die Mobilität folgendermaßen bestimmt werden:

$$\nu_{ij} = \nu_0 \exp[-2\gamma a(\Delta R_{ij}/a)]$$

In diesem Modell wird ein Festkörper schematisch gesehen aus den Plätzen i und j aufgebaut, auf denen sich die Ladungsträger befinden können. Jeder Platz repräsentiert einen lokalisierten Zustand. Der Transport eines Ladungsträgers zwischen den Plätzen i und j wird durch einen Widerstand R_{ij} dargestellt. Die Größe des temperaturabhängigen Widerstands spiegelt dabei den

räumlichen Abstand zwischen den Plätzen und die benötigte Aktivierungsenergie für den Übergang wider. Der Parameter γ steht für den Abfall der elektronischen Wellenfunktion der Ladungsträger, a ist der Parameter für den durchschnittlichen Gitterabstand. Die Phononenfrequenz ν_0 gibt die Anzahl der Versuche eines Ladungsträgers aus einem lokalisierten Zustand in einen anderen lokalisierten Zustand zu gelangen an, liegt im Bereich von etwa 10^{13} s^{-1} und berücksichtigt die Stärke der Elektronenphononkopplung.

Die elektronische Vorrichtung kann weiterhin eine organische, funktionelle Schicht aufweisen, die aus einer Gruppe ausgewählt ist, die Emissionsschichten, Elektronentransportschichten, Lochtransportschichten, Elektronenblockierschichten, Lochblockierschichten, Lochinjektionsschichten, Elektroneninjektionsschichten und Zwischenschichten umfasst. Mit Zwischenschichten werden Schichten bezeichnet, die zwischen zwei Emissionsschichten angeordnet sind. Je nachdem, was für eine organische, funktionelle Schicht ausgewählt wird, können diese Schichten noch zusätzliche Dotierstoffe enthalten. Die organische, funktionelle Schicht kann eine Emissionsschicht sein und mit zumindest einem Emittermaterial dotiert sein. Emittermaterialien können kleine Moleküle oder Polymere umfassen. Die Konzentration des Emittermaterials in einer Emissionsschicht kann bis zu 10 Gew% betragen. Weiterhin kann das Emittermaterial aufgrund der niedrigen Konzentration in der Emissionsschicht nur eine geringe Ladungsträgermobilität aufweisen und damit nur geringfügig zum Ladungsträgertransport beitragen.

In der Emissionsschicht können auch zwei oder drei Emittermaterialien vorhanden sein. Die Emittermaterialien

können beispielsweise ausgewählt sein aus dem grün emittierenden $Ir(ppy)_3$ (Tris(2-phenylpyridin)iridium(III)), dem rot emittierenden $Ir(piq)_3$ (Tris(1-phenylisoquinolin)iridium(III)) oder dem blau emittierenden Firpic (Bis(3,5-Difluoro-2-(2-pyridyl)phenyl-(2-carboxypyridyl)iridium(III)).

Die Konzentrationen des Emittiermaterials und der Matrixmaterialien in der organischen funktionellen Schicht können innerhalb der organischen funktionellen Schicht einen Gradienten aufweisen. Damit kann beispielsweise die Konzentration des Emittermaterials in einem ersten Teilbereich der Schicht höher sein als in einem zweiten Teilbereich der Schicht.

Durch Verzicht auf die Dotierung mit Emittermaterialien lassen sich Transport-, Zwischen- und Blockierschichten herstellen.

In einer elektronischen Vorrichtung können auch mehrere organische, funktionelle Schichten vorhanden sein, wobei die Schichten unterschiedliche Funktionen oder gleiche Funktionen aufweisen können. Beispielsweise kann eine elektronische Vorrichtung eine Abfolge mehrerer funktioneller, organischer Schichten aufweisen, die beispielsweise zusammengesetzt ist aus einer Lochinjektionsschicht, einer Lochtransportschicht, einer ersten Emissionsschicht, einer Zwischenschicht, einer zweiten Emissionsschicht, einer Elektronentransportschicht und einer Elektroneninjektionsschicht. Jede dieser Schichten kann eine Matrix aufweisen, die mindestens ein erstes, ein zweites und ein drittes Matrixmaterial aufweist. Die Matrixmaterialien in den verschiedenen organischen

funktionellen Schichten können in allen Schichten gleich oder unterschiedlich gewählt werden.

Je nachdem, wo sich die Emissionsschicht in dem Schichtstapel der elektronischen Vorrichtung befindet, kann dort die Mobilität von Elektronen und Löchern innerhalb dieser Schicht getrennt voneinander optimiert werden, wenn die Emissionsschicht ein erstes, ein zweites und ein drittes Matrixmaterial aufweist. Die Mobilität kann auch über mehrere Schichten hinweg optimiert werden.

Auch wenn die Emissionsschicht, die die drei Matrixmaterialien aufweist, nahe einer Anode oder einer Kathode liegt, kann die Mobilität von Elektronen und Löchern so eingestellt werden, dass das Verhältnis von Löchern und Elektronen in der Emissionsschicht ausgeglichen ist. Je nachdem, welche Ladungsträgersorte eine höhere Beweglichkeit aufweisen soll, kann die Matrix eine höhere Konzentration des jeweiligen Matrixmaterials enthalten. So kann in der Emissionsschicht, unabhängig von der Lage der Emissionsschicht der elektronischen Vorrichtung, eine hohe Anzahl an Exzitonen gebildet werden.

Wenn die organische, funktionelle Schicht eine Emissionsschicht mit einem Emittermaterial ist, kann das LUMO des Emittermaterials energetisch niedriger als das LUMO des ersten, zweiten und dritten Matrixmaterials sein und das HOMO des Emittermaterials energetisch höher als das HOMO des ersten, zweiten und dritten Matrixmaterials sein. Somit ist die Bandlücke zwischen HOMO und LUMO des Emittermaterials kleiner als die Bandlücken der drei Matrixmaterialien und liegt zudem energetisch zwischen allen Bandlücken aller

Matrixmaterialien. Ein ambipolarer Ladungstransport in einer Emissionsschicht ist somit möglich.

Die Moleküle des zweiten und dritten Matrixmaterials transportieren bevorzugt nur jeweils eine Ladungsträgersorte, Löcher oder Elektronen, somit bilden sich auf ihnen keine Exzitonen. Damit wird die Lebensdauer der Materialien erhöht, da keine Degradation durch Anregungsenergie stattfinden kann. Zwischen den verschiedenen Molekülen der Matrixmaterialien entstehen angeregte Zustände (Eximere), die ihre Anregungsenergie durch Energietransfer auf die Emittermoleküle übertragen können. Somit wird die Effizienz der elektronischen Vorrichtung weiterhin erhöht.

Eine elektronische Vorrichtung kann auch mehrere Emissionsschichten aufweisen, beispielsweise um phosphoreszente und fluoreszente Emittermaterialien in einer Vorrichtung zu kombinieren. Dann kann das Einfügen einer Zwischenschicht zwischen den Emissionsschichten notwendig sein, die beispielsweise ambipolare Ladungstransporteigenschaften aufweisen kann. Dies ist durch die Kombination von drei Matrixmaterialien möglich.

Durch Einstellung der Ladungsträgermobilität mit Hilfe der drei Matrixmaterialien ist es möglich, die Lage der Rekombinationszone in einer Emissionsschicht gezielt zu beeinflussen. Die Rekombinationszone kann sich dabei innerhalb einer Schicht oder über mehrere Schichten verteilt befinden. Durch die Einführung der ersten Matrix, die keinen Ladungstransport aufweist, innerhalb einer Emissionsschicht sinkt der absolute Wert der Ladungsträgermobilität. Daraus ergibt sich eine Rekombinationszone, die Zone in der Exzitonen gebildet werden, die von den Rändern einer

emittierenden Schicht zur Mitte hin verschoben wird. Dies erhöht die Effizienz der Vorrichtung, da unter anderem die nicht strahlende Abregung von Exzitonen (Quenching) vermindert wird und mehr Exzitonen in der eigentlichen Emissionsschicht gebildet werden, statt in den angrenzenden Schichten.

Bei der elektronischen Vorrichtung kann es sich um eine strahlungsemittierende Vorrichtung beispielsweise um eine organische Licht emittierende Vorrichtung handeln. Diese Licht emittierende Vorrichtung kann eine organische, Licht emittierende Diode (OLED) sein. Weiterhin kann die elektronische Vorrichtung eine Solarzelle oder einen Transistor umfassen.

Beispielsweise ist die zumindest eine organische, funktionelle Schicht bei einem Transistor zwischen der ersten und zweiten Elektrode angeordnet. Weiterhin ist eine dritte Elektrode vorhanden. Die Elektroden können aus Gate-, Source- und Drain-Elektrode ausgewählt sein. Ein Transistor kann zum Schalten oder Verstärken von elektrischen Signalen verwendet werden.

Bei einer Solarzelle kann Licht in elektrische Energie umgewandelt werden. Hier ist die organische, funktionelle Schicht zwischen der ersten und der zweiten Elektrode angeordnet, wobei zumindest eine der Elektroden transparent ausgeformt ist.

Die Vorrichtung kann in einer organischen funktionellen Schicht als erstes Matrixmaterial beispielsweise mCP (*m*-Bis(N-carbazolylbenzol)), als zweites Matrixmaterial, das ein Lochtransportmaterial sein kann, TCTA (9H-carbazol,9,9',9''-

(1,3,5-Benzoltriyl)tris-(9Cl)), und als drittes Matrixmaterial, das ein Elektronentransportmaterial sein kann, beispielsweise TPBi (1,3,5-Tris(N-Phenylbenzylimidazol-2-yl) aufweisen. Soll eine Matrix für eine Emissionsschicht bereitgestellt werden, kann als Emittermaterial beispielsweise der gelbe Emitter Rubren (5,6,11,12-Tetraphenylnaphthacen) eingefügt werden.

Es wird weiterhin ein Verfahren zur Herstellung einer elektronischen Vorrichtung mit den oben beschriebenen Eigenschaften bereitgestellt. Das Verfahren umfasst die Verfahrensschritte A) Bereitstellen eines Substrats, B) Bereitstellen einer ersten Elektrode und einer zweiten Elektrode, C) Anordnen zumindest einer organischen Schicht zwischen der ersten Elektrode und der zweiten Elektrode Beispielsweise kann die zumindest eine organische, funktionelle Schicht auf der ersten Elektrode und die zweite Elektrode auf der organischen, funktionellen Schicht angeordnet werden. Im Verfahrensschritt C) wird dabei mindestens ein erstes Matrixmaterial, ein zweites Matrixmaterial und ein drittes Matrixmaterial gleichzeitig aufgebracht. Das Aufbringen im Verfahrensschritt C) kann beispielsweise durch Aufdampfen (Koevaporation) geschehen. Durch das gleichzeitige Aufbringen kann die Konzentration des jeweiligen Matrixmaterials unabhängig von den anderen Matrixmaterialien bestimmt werden, sodass die Matrixmaterialien in verschiedenen Konzentrationen aufgebracht werden können.

Anhand der Figuren und Ausführungsbeispiele soll die Erfindung näher erläutert werden:

Figur 1 zeigt die schematische Seitenansicht einer elektronischen Vorrichtung,

Figur 2 zeigt eine schematische Ansicht der energetischen Zustände der verschiedenen Matrixmaterialien,

Figur 3 zeigt eine schematische Seitenansicht einer elektronischen Vorrichtung,

Figur 4 zeigt die Simulation der Mobilität der Ladungsträger in einer Emissionsschicht,

Figur 5 zeigt den schematischen Aufbau zur Herstellung einer Schicht mit mehreren Matrixmaterialien.

Figur 1 zeigt die schematische Seitenansicht einer elektronischen Vorrichtung, die ein Substrat 10, eine erste Elektrode 20, eine Emissionsschicht 30 und eine zweite Elektrode 40 umfasst. Die erste Elektrode kann beispielsweise eine Anode und die zweite Elektrode eine Kathode sein. Je nachdem, ob das Substrat und die erste Elektrode oder die zweite Elektrode transparent ausgeformt sind, kann es sich bei der elektronischen Vorrichtung um eine Bottom-emittierende oder eine Top-emittierende Vorrichtung, beispielsweise eine OLED, handeln. Die Emissionsschicht 30 kann ein erstes, ein zweites und ein drittes Matrixmaterial aufweisen und mit einem Emittermaterial dotiert sein.

Figur 2 zeigt die schematische Darstellung der Energieniveaus der jeweiligen Materialien in der Emissionsschicht in einer beispielhaften Ausführungsform. Es ist das HOMO und LUMO des ersten Matrixmaterials 30N, des zweiten Matrixmaterials 30B und des dritten Matrixmaterials 30A gezeigt. Das erste

Matrixmaterial weist ein HOMO auf, das energetisch niedriger liegt als das HOMO des zweiten Matrixmaterials und des dritten Matrixmaterials. Weiterhin weist das erste Matrixmaterial ein LUMO auf, das energetisch höher liegt als das LUMO des zweiten Matrixmaterials und des dritten Matrixmaterials. Das zweite Matrixmaterial weist ein LUMO auf, das energetisch höher liegt als das LUMO des dritten Matrixmaterials und ein HOMO, das energetisch höher liegt als das HOMO des dritten Matrixmaterials. Damit weist das erste Matrixmaterial geringere Ladungsträgermobilitäten als die beiden anderen Matrixmaterialien auf, das zweite Matrixmaterial kann ein Lochtransportmaterial und das dritte Matrixmaterial ein Elektronentransportmaterial umfassen.

Das Emittermaterial 30E weist ein HOMO und LUMO auf, das die geringste Bandlücke im Vergleich zu den Matrixmaterialien hat und zwischen den LUMOs und den HOMOs der drei Matrixmaterialien liegt.

Rechts in dem Schema ist die Summe der verschiedenen Energieniveaus aufgezeigt. A symbolisiert das Energieniveau, bei dem der Elektronentransport stattfindet, B symbolisiert das Energieniveau, bei dem Lochtransport stattfindet. d1 und d2 stehen für die energetischen Abstände zwischen den LUMOs des ersten und zweiten Matrixmaterials (d1) und den HOMOs des ersten und dritten Matrixmaterials (d2). d3 symbolisiert die Bandlücke des Emittermaterials. Wird kein Emittermaterial eingesetzt, kann es sich bei der Schicht auch um eine Ladungsträgertransport-, Ladungsträgerinjektions- oder Ladungsträgerblockierschicht handeln. Weiterhin können auch mehrere Emittermaterialien eingesetzt werden. Das Emittermaterial weist in der Emissionsschicht eine Konzentration von ≤ 10 Gew% auf.

Figur 3 zeigt die schematische Seitenansicht einer weiteren Ausführungsform der elektronischen Vorrichtung, die eine Emissionsschicht 30 aufweist, an die jeweils auf einer Seite eine Elektronentransportschicht 32 und eine Lochtransportschicht 31 angrenzt. Hier handelt es sich bei der ersten Elektrode 20 um eine Anode.
Sowohl die Emissionsschicht 30 als auch die Elektronentransportschicht 32 und die Lochtransportschicht 31 können Matrizen aufweisen, die sich aus drei oder mehr Matrixmaterialien zusammensetzen.

Figur 4 zeigt die Simulation des Ladungsträgertransports in einer OLED, in der eine Emissionsschicht, eine Lochtransportschicht 31 und eine Elektronentransportschicht 32 vorhanden ist. Die x-Achse zeigt die Entfernung der jeweiligen Schicht von der Anode D [nm], die y-Achse zeigt die normierte Rekombinationsrate R_n. Man kann sehen, dass mit Verringerung des absoluten Wertes der Ladungsträgermobilität in der Emissionsschicht 30 im Vergleich zu der Lochtransportschicht 31 und der Elektronentransportschicht 32 die Rekombinationszone von den Rändern der Emissionsschicht zur Mitte hin verschoben wird. Das heißt, mit sinkender Mobilität der Ladungsträger in der Emissionsschicht 30 verringert sich die Rekombination in den angrenzenden Schichten 32 und 31 und verschiebt sich zur Mitte der Emissionsschicht 30.

Bei der Simulation wurden Elektronen- und Lochmobilität in der Emissionsschicht gleichgesetzt, also ein ambipolarer Ladungstransport angenommen. Es wurde ohmsche Injektion angenommen, alle Energiebarrieren zwischen HOMO und LUMO der zwei Schichten betrugen 400 meV für die jeweilige Ladungsträgersorte. In dem Diagramm sind für die

verschiedenen Linienformen die jeweiligen Mobilitäten der Ladungsträger in m^2/Vs angegeben, sie bewegen sich zwischen 10^{-8} bis zu 10^{-12}.

Figur 5 zeigt die schematische Seitenansicht eines Aufbaus zur Herstellung der elektronischen Vorrichtung. Auf einer Halterung 51 sind beispielhaft vier Verdampfungsquellen 50 aufgebracht, aus denen jeweils Matrixmaterialien und/oder Dotierstoffe auf das Abscheidesubstrat 60 aufgedampft werden können. Um die jeweilige Konzentration des Matrixmaterials und/oder des Dotierstoffs genau bestimmen zu können, wird die Verdampfungsrate über Schichtdickenmonitore 55 gemessen und eingestellt. Bei den Schichtdickenmonitoren kann es sich beispielsweise um Schwingquarze handeln.

Beispielsweise kann mit einem Aufbau gemäß Figur 5 eine Emissionsschicht hergestellt werden, die ein erstes Matrixmaterial enthält, das mCP (*m*-Bis(N-carbazolylbenzol)) umfasst und mit einer Aufdampfrate von 3,8 Å/s aufgebracht wird. Das zweite Matrixmaterial, das Lochtransportmaterial kann TCTA (9H-carbazol,9,9',9''-(1,3,5-Benzoltriyl)tris-(9Cl)) sein und mit einer Aufdampfrate von 8 Å/S aufgebracht werden. Das dritte Matrixmaterial, das Elektronen-transportmaterial, kann beispielsweise TPBi (1,3,5-Tris(N-Phenylbenzylimidazol-2-yl) sein und mit einer Aufdampfrate von 8 Å/S aufgebracht werden. Als Emittermaterial kann beispielsweise der gelbe Emitter Rubren (5,6,11,12-Tetraphenylnaphthacen) eingebracht werden und mit einer Aufdampfrate von 0,2 Å/S aufgebracht werden. Damit ergibt sich eine Schicht mit einer Volumenkonzentration von 40% für die Ladungsträgertransportmaterialien und 1% für den Emitter. In Tabelle 1 sind die HOMOs und LUMOs dieser Materialien angegeben. Die Werte der HOMOs von TCTA, TPBi, mCP wurden

mittels UV-Photoemissionsspektroskopie bestimmt, die korrespondierenden LUMO-Werte wurden abgeschätzt, indem die für die Absorption benötigte Energie zu dem HOMO-Wert dazugezählt wurde. Der HOMO- und LUMO-Wert von Rubren wurde mittels Cyclovoltammetrie und Photoelektronenspetrometrie bestimmt.

	HOMO [eV]	LUMO [eV]
mCP	-5,9	-2,4
TCTA	-5,7	-2,3
TPBi	-6,3	-2,8
Rubren	-5,5	-3,0

Tabelle 1

Das dritte Matrixmaterial TPBi weist den im Vergleich mit den anderen Matrixmaterialien niedrigsten Wert für das LUMO auf und ist somit Elektronentransportmaterial. Das zweite Matrixmaterial TCTA weist den im Vergleich mit den anderen Matrixmaterialien größten Wert für das HOMO auf und ist somit Lochtransportmaterial. Das erste Matrixmaterial mCP ist nicht am Ladungsträgertransport beteiligt, da sein LUMO nicht niedriger als das LUMO des dritten Matrixmaterials ist und sein HOMO nicht höher als das HOMO des zweiten Matrixmaterials ist.

Weitere mögliche Lochtransportmaterialien sind:

NPB	N,N'-Bis(Naphthalen-1-yl)-N,N'-bis(phenyl)-Benzidin
TCTA	4,4',4''-Tris(carbazol-9-yl)triphenylamin
CPB	4,4'-Bis(carbazol-9-yl)biphenyl
1T-NATA	4,4',4''-Tris(N-(1-naphthyl)-N-phenyl-amino)triphenylamin
Spiro-TAD	2,2',7,7'-Tetrakis(N,N-diphenylamino)-9,9'-spirobifluoren

Als Elektronentransportmaterialien können weiterhin eingesetzt werden:

TPBi	2,2',2''-(1,3,5-Benzintriyl)-tris(1-phenyl-1-H-benzimidazol)
TAZ	3-(4-Biphenylyl)-4-Phenyl-5-tert-butylphenyl-1,2,4-triazol
Alq_3	Tris(8-Hydroxy-quinolinato)aluminium
BCP	2,9-Dimethyl-4,7-diphenyl-1,10-phenanthrolin
NTAZ	4-(Naphthalen-1-yl)-3,5-diphenyl-4H-1,2,4-triazol
Balq	Bis-(2-methyl-8-quinolinolat)-4-(phenylphenolato)aluminium

Als erstes Matrixmaterial, das im Vergleich zu den anderen Matrixmaterialien die geringste Ladungsträgermobilität aufweist, kann eingesetzt werden:

UGH-2	1,4-Bis(triphenylsilyl)benzol
UGH-3	1,3-Bis(triphenylsilyl)benzol
mCP	1,3-Bis(carbazol-9-Yl)benzol

Die HOMOs von UGH-2 und UGH-3 haben Werte von -7,2 ± 0,1 eV, die LUMOs liegen bei 2,8 eV. Diese HOMO-Werte können mittels Photoelektronenspektroskopie bestimmt werden, die LUMO-Werte können aus dem Abstand von HOMO-Werten und LUMO-Werten am Schnittpunkt des Absorptions- und des Fluoreszenzspektrums abgeschätzt werden.

Mögliche Emittermaterialien sind:

$Ir(ppy)_3$	Tris(2-phenylpyridin)iridum(III)
$Ir(ppy)_2$ (acac)	Bis(2-phenylpyridlin)(acetylacetonat)iridium(II)
BczVBi	4,4'-Bis(9-ethyl-3-carbazovinylen)-1,1'-biphenyl

FirPic	Bis(3,5-Difluoro-2-(2-pyridyl)phenyl-(2-carboxy-pyridyl)iridium(III)
Rubren	Tetraphenylnaphthacen
$Ir(piq)_3$	Tris(1-phenylisoquinolin)iridium(III)

Bei diesen Emittermaterialien handelt es sich um kleine, nicht-polymere Moleküle. Der Einsatz von polymeren Emittermaterialien ist ebenso möglich.

Weitere mögliche Materialien, die je nach Lage ihrer HOMOs und LUMOs zueinander als erste, zweite oder dritte Matrix eingesetzt werden können, sind:

Bphen	4,7-Diphenyl-1,10-phenanthrolin
DPAVBi	4,4'-Bis(2-(4-(N,N-diphenylamino)phenyl)vinyl)biphenyl
CuPC	Phthalocyanin Kupfer Komplex
S-DPVBi	2,2',7,7'-Tetrakis(2,2-diphenylvinyl)spiro-9,9'-bifluorenCPF
TAPC	1,1-Bis-(4-bis(4-methylphenyl)-aminophenyl)-cyclohexan
TBADN	9,10-Bis(2-naphthyl)-2-t-butylanthracen
TPD	N,N,N',N'-Tetraphenylbenzidin

Einige der Elektronen- und Lochtransportmaterialien können auch als erstes Matrixmaterial dienen. Wichtig bei der Zusammenstellung des ersten, zweiten und dritten Matrixmaterials für die Matrix sind das relative Verhältnis der LUMOs und HOMOs der drei kombinierten Materialien und deren Lage zueinander.

Die Matrix kann für phosphoreszente Emitter aufgrund der chemischen Verträglichkeit nicht beliebig gewählt werden. Der rote Emitter Iridium (III)bis(2-methyldibenzo-

[f,h]quinoxalin)-acetylacetonat) ist nur in einer NBP-Matrix effizient. NPB ist jedoch ein Lochtransportmaterial. Befindet sich nun anodenseitig noch eine weitere Emitterschicht, wird diese nicht ausreichend mit Elektronen versorgt. Durch Eindotierung eines Elektronentransportmaterials, beispielsweise BCP, können die relativen Transporteigenschaften eingestellt werden. Die Feinabstimmung der Transporteigenschaften erfolgt mit UGH4.

Die in den Figuren und Ausführungsbeispielen gezeigten Ausführungsformen können beliebig variiert werden. Es ist weiterhin zu berücksichtigen, dass sich die Erfindung nicht auf die Beispiele beschränkt, sondern weitere, hier nicht aufgeführte Ausgestaltungen zulässt.

Patentansprüche

1. Elektronische Vorrichtung, umfassend
   - ein Substrat,
   - eine erste Elektrode,
   - zumindest eine organische, funktionelle Schicht, und
   - eine zweite Elektrode, wobei die zumindest eine organische, funktionelle Schicht zwischen der ersten Elektrode und der zweiten Elektrode angeordnet ist und wobei die zumindest eine organische, funktionelle Schicht mindestens ein erstes Matrixmaterial, ein zweites Matrixmaterial und ein drittes Matrixmaterial aufweist und das dritte Matrixmaterial ein Lowest Unoccupied Molecular Orbital (LUMO), das energetisch niedriger als das LUMO des zweiten Matrixmaterials und das LUMO des ersten Matrixmaterials ist, und wobei das zweite Matrixmaterial ein Highest Occupied Molecular Orbital (HOMO), das energetisch höher als das HOMO des ersten Matrixmaterials und das HOMO des dritten Matrixmaterials ist, aufweist.

2. Elektronische Vorrichtung nach dem vorhergehenden Anspruch, wobei das erste Matrixmaterial ein LUMO, das energetisch höher als das LUMO des zweiten Matrixmaterial und das LUMO des dritten Matrixmaterials ist, und ein HOMO, das energetisch niedriger als das HOMO des zweiten Matrixmaterials und das HOMO des dritten Matrixmaterials ist, aufweist.

3. Elektronische Vorrichtung nach dem vorhergehenden Anspruch, wobei das zweite Matrixmaterial ein LUMO, das energetisch höher als das LUMO des dritten Matrixmaterials ist, und ein HOMO, das energetisch höher als das HOMO des dritten Matrixmaterials ist, aufweist.

4. Elektronische Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das erste Matrixmaterial eine

Ladungsträgermobilität aufweist, die geringer ist als die Ladungsträgermobilitäten des zweiten und dritten Matrixmaterials.

5. Elektronische Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das zweite Matrixmaterial ein Lochtransportmaterial umfasst.

6. Elektronische Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das dritte Matrixmaterial ein Elektronentransportmaterial umfasst.

7. Elektronische Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die organische, funktionelle Schicht ausgewählt ist aus einer Gruppe, die Emissionsschichten, Elektronentransportschichten, Lochtransportschichten, Elektronenblockierschichten, Lochblockierschichten, Lochinjektionsschichten, Elektroneninjektionsschichten und Zwischenschichten umfasst.

8. Elektronische Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die organische, funktionelle Schicht eine Emissionsschicht ist und mit zumindest einem Emittermaterial dotiert ist.

9. Elektronische Vorrichtung nach dem vorhergehenden Anspruch, wobei das Emittermaterial in der Emissionsschicht eine Konzentration von $\leq$ 10 Gew% aufweist.

10. Elektronische Vorrichtung nach dem vorhergehenden Anspruch, wobei die Konzentration des Emittermaterials in der Emissionsschicht einen Gradienten aufweist.

11. Elektronische Vorrichtung nach einem der Ansprüche 8 bis 10, wobei das LUMO des Emittermaterials energetisch niedriger als das LUMO des ersten, zweiten und dritten

Matrixmaterials ist und das HOMO des Emittermaterials energetisch höher als das HOMO des ersten, zweiten und dritten Matrixmaterials ist.

12. Elektronische Vorrichtung nach einem der vorhergehenden Ansprüche, die als strahlungsemittierende Vorrichtung ausgebildet ist.

13. Elektronische Vorrichtung nach einem der Ansprüche 1 bis 11, wobei die Vorrichtung ausgewählt ist aus einer Gruppe, die eine organische Licht emittierende Vorrichtung, eine Solarzelle und einen Transistor umfasst.

14. Verfahren zur Herstellung einer elektronischen Vorrichtung gemäß den Ansprüchen 1 bis 13, mit den Verfahrensschritten
A) Bereitstellen eines Substrats,
B) Bereitstellen einer ersten Elektrode und einer zweiten Elektrode,
C) Anordnen zumindest einer organischen, funktionellen Schicht zwischen der ersten Elektrode und der zweiten Elektrode
wobei im Verfahrensschritt C) mindestens das erste Matrixmaterial, das zweite Matrixmaterial und das dritte Matrixmaterial gleichzeitig aufgebracht werden.

15. Verfahren nach dem vorhergehenden Anspruch, wobei im Verfahrensschritt C) das erste Matrixmaterial, das zweite Matrixmaterial und das dritte Matrixmaterial durch Aufdampfen aufgebracht werden.

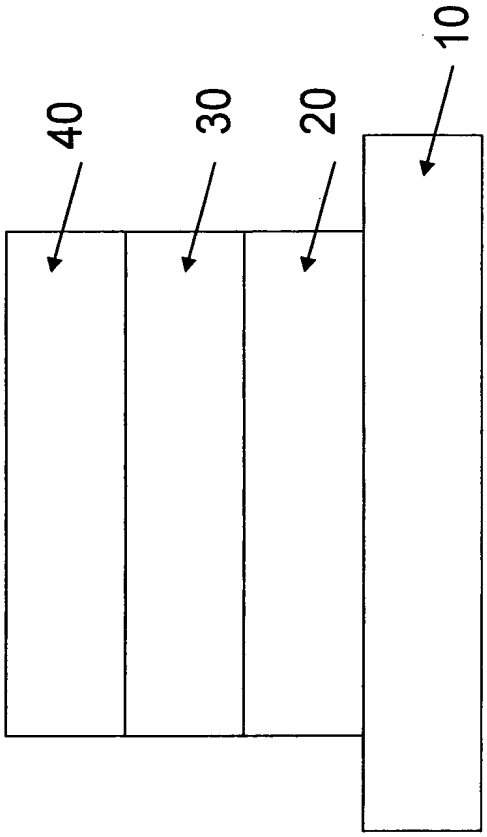


Fig. 1

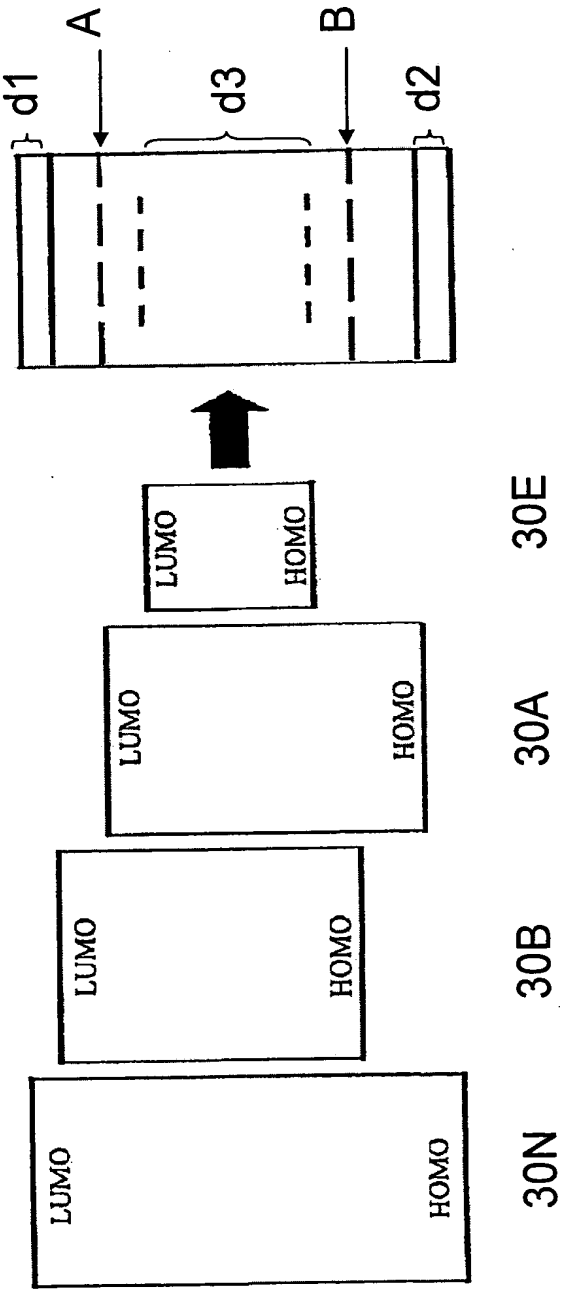

A
B
d1
d3
d2
LUMO
HOMO
30E
LUMO
HOMO
30A
LUMO
HOMO
30B
LUMO
HOMO
30N

Fig. 2

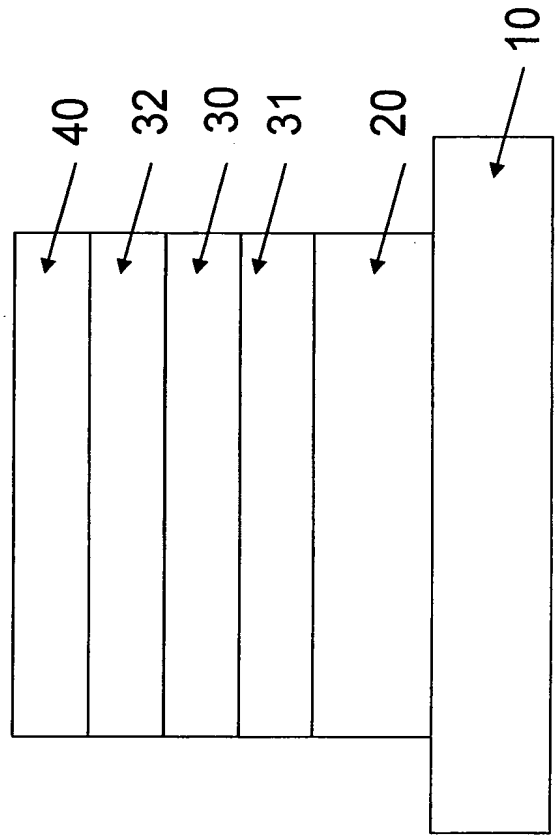


Fig. 3

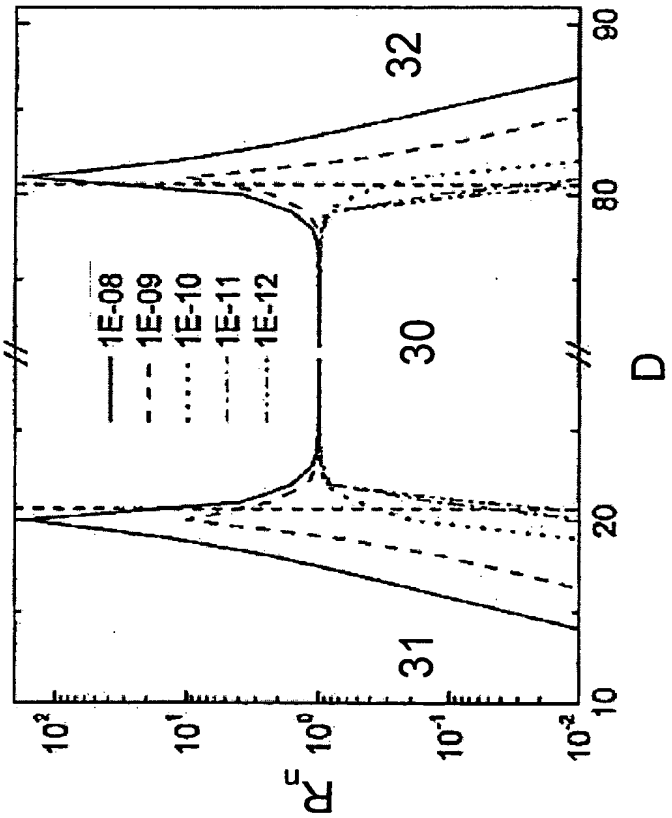

32
30
31
1E-08
1E-09
1E-10
1E-11
1E-12
90
80
20
10
D
10^{2}
10^{1}
10^{0}
10^{-1}
10^{-2}
α^{c}

Fig. 4

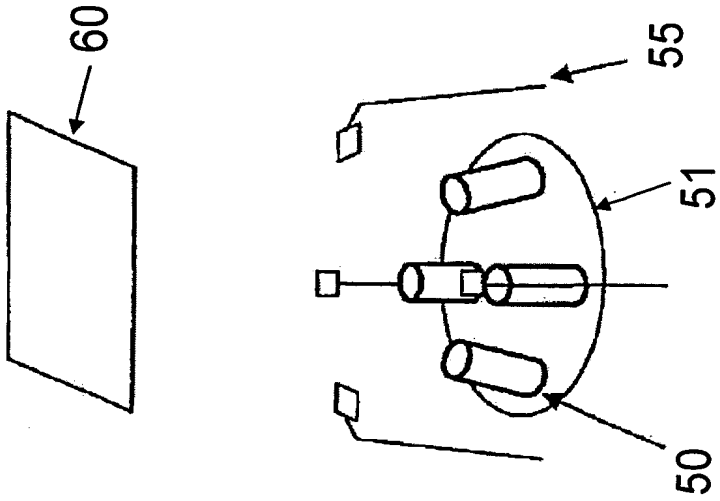


Fig. 5

Zusammenfassung

Elektronische Vorrichtung

Es wird eine Elektronische Vorrichtung, umfassend ein Substrat, eine erste Elektrode, zumindest eine organische, funktionelle Schicht und eine zweite Elektrode angegeben. Die organische, funktionelle Schicht umfasst ein erstes, ein zweites und ein drittes Matrixmaterial, wobei das erste Matrixmaterial eine größere Bandlücke als das zweite und das dritte Matrixmaterial aufweist.

Signifikante Figur 1

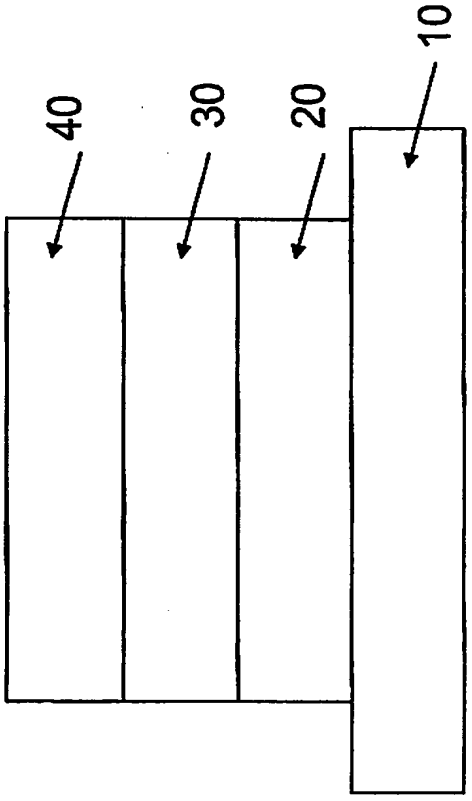


Fig. 1

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BUNDESREPUBLIK DEUTSCHLAND

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Bezeichnung:	Strahlungsemittierende Vorrichtung
IPC:	H 01 L 51/50, H 01 L 51/56

Die angehefteten Stücke sind eine richtige und genaue Wiedergabe der Teile der am 30. Mai 2008 eingereichten Unterlagen dieser Patentanmeldung unabhängig von gegebenenfalls durch das Kopierverfahren bedingten Farbabweichungen.

München, den 16. September 2009
Deutsches Patent- und Markenamt
Die Präsidentin
Im Auftrag

Dreer

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Beschreibung

Strahlungsemittierende Vorrichtung

Die Erfindung betrifft eine strahlungsemittierende Vorrichtung und ein Verfahren zur Herstellung einer strahlungsemittierenden Vorrichtung.

Strahlungsemittierende Vorrichtungen, wie beispielsweise organische Leuchtdioden (OLEDs), bestehen aus einer Abfolge mehrerer funktioneller organischer Schichten. Emissionsschichten weisen dabei ein Matrixmaterial auf, welches mit Emittermolekülen dotiert wird. In der Emissionsschicht werden Exzitonen durch Rekombination von Elektronen und „Löchern" gebildet, die zur Lichtemission führen. Um eine hohe Effizienz der strahlungsemittierenden Vorrichtung zu erhalten, ist das Verhältnis zwischen Elektronen und „Löchern", die in der Emissionsschicht transportiert werden, entscheidend. Ein nicht ausgeglichenes Verhältnis zwischen Loch- und Elektronentransport resultiert in einer geringen Strahlungseffizienz der Vorrichtung.

Aufgabe der Erfindung ist es, eine strahlungsemittierende Vorrichtung bereitzustellen, die einen verbesserten Ladungsträgertransport und eine verbesserte Ladungsträgerbalance in den organischen Schichten und damit eine erhöhte Effizienz aufweist. Eine weitere Aufgabe der Erfindung ist es, ein Verfahren zur Herstellung einer strahlungsemittierenden Vorrichtung bereitzustellen. Diese Aufgaben werden durch eine strahlungsemittierende Vorrichtung gemäß Anspruch 1 und einem Verfahren zur Herstellung der strahlungsemittierenden Vorrichtung gemäß Anspruch 10 gelöst.

Weitere Ausführungsformen der Vorrichtung und des Verfahrens sind Gegenstand weiterer Ansprüche.

Gemäß einer Ausführungsform wird eine strahlungsemittierende Vorrichtung bereitgestellt, die ein Substrat, eine erste Elektrode auf dem Substrat, zumindest eine organische, funktionelle Schicht auf der ersten Elektrode und eine zweite Elektrode auf der zumindest einen organischen, funktionellen Schicht umfasst. Die zumindest eine organische, funktionelle Schicht weist mindestens ein erstes Matrixmaterial, ein zweites Matrixmaterial und ein drittes Matrixmaterial auf, wobei das erste Matrixmaterial ein Lowest Unoccupied Molecular Orbital (LUMO), das energetisch höher als das LUMO des zweiten Matrixmaterials und das LUMO des dritten Matrixmaterials ist, und ein Highest Occupied Molecular Orbital (HOMO), das energetisch niedriger als das HOMO des zweiten Matrixmaterials und das HOMO des dritten Matrixmaterials ist. Damit wird eine strahlungsemittierende Vorrichtung bereitgestellt, die mehr als zwei verschiedene Matrixmaterialien in einer organischen funktionellen Schicht umfasst. Dabei können drei verschiedene Matrixmaterialien vorhanden sein, je nach Bedarf auch mehr als drei.

Nach der Molekülorbitaltheorie sind in einem Molekül verschiedene Molekülorbitale mit verschiedenen Energieniveaus vorhanden, die von den vorhandenen Elektronen besetzt werden können. Diese Molekülorbitale werden nach zunehmendem Energieniveau besetzt. Das LUMO ist das energetisch niedrigste Molekülorbital, das nicht mehr mit einem Elektron besetzt ist. Das HOMO ist das energetisch am höchsten gelegene Molekülorbital, das noch mit einem Elektron besetzt ist.

Diese strahlungsemittierende Vorrichtung weist einen verbesserten Ladungsträgertransport und eine verbesserte Ladungsträgerbalance in der organischen funktionellen Schicht auf, und ein anpassbares Verhältnis zwischen Loch- und Elektronentransport. Das erste Matrixmaterial ist dabei so gewählt, dass es eine große Bandlücke, also die Differenz zwischen HOMO und LUMO aufweist, so dass sein HOMO energetisch unter dem HOMO der anderen beiden Matrixmaterialien und sein LUMO energetisch über dem LUMO der anderen beiden Matrixmaterialien liegt.

Weiterhin kann in der strahlungsemittierenden Vorrichtung das zweite Matrixmaterial ein LUMO, das energetisch höher als das LUMO des dritten Matrixmaterials ist, und ein HOMO, das energetisch höher als das HOMO des dritten Matrixmaterials ist, aufweisen. Damit weist das erste Matrixmaterial die größte Bandlücke zwischen HOMO und LUMO im Vergleich zum zweiten und zum dritten Matrixmaterial auf und das zweite Matrixmaterial weist Bandlücke auf, die zu der Bandlücke des dritten Matrixmaterials energetisch verschoben ist. Damit können auf dem LUMO des dritten Matrixmaterials Elektronen transportiert werden, und auf dem HOMO des zweiten Matrixmaterials Löcher transportiert werden, da diese Energieniveaus jeweils am energetisch günstigsten für den jeweiligen Ladungstransport sind.

Das erste Matrixmaterial kann in der strahlungsemittierenden Vorrichtung Ladungsträgermobilität aufweisen, die geringer ist als die Ladungsträgermobilität des zweiten und des dritten Matrixmaterials. Das erste Matrixmaterial kann ein Ultra Wide Band Gap (UGH)-Material sein, welches eine im Vergleich zu den übrigen Matrixmaterialien große Bandlücke

aufweist. Dadurch kann es keinen Anteil am Ladungsträgertransport aufweisen.

Das zweite Matrixmaterial kann weiterhin ein Lochtransportmaterial umfassen und das dritte Matrixmaterial kann ein Elektronentransportmaterial umfassen.

Der Ladungsträgertransport, also der Lochtransport und der Elektronentransport, hängt insbesondere von der Mobilität der Löcher beziehungsweise der Elektronen in einem Material und von der Lage der Energieniveaus HOMO und LUMO der Matrixmaterialien ab. Das HOMO und LUMO eines Materials ist dabei für die Ladungsträgerinjektion verantwortlich.

Zur Erzeugung eines Lochs in der Matrix, die sich aus den drei Matrixmaterialien zusammensetzt, muss beispielsweise ein Elektron aus dem HOMO entfernt werden, was bei einem energetisch tief liegenden HOMO schwieriger ist als bei einem energetisch höher liegenden. Somit ist das zweite Matrixmaterial, das ein höher gelegenes HOMO als das dritte Matrixmaterial aufweist, besser als Lochtransportmaterial geeignet, als das dritte Matrixmaterial. Analoges gilt für die Erzeugung von Elektronen in LUMOs, die bei energetisch tiefer gelegenen LUMOs energetisch begünstigt ist. Somit eignet sich das dritte Matrixmaterial, das ein niedrigeres LUMO als das zweite Matrixmaterial aufweist, als Elektronentransportmaterial.

Sind Löcher und Elektronen erzeugt, spielt weiterhin die Mobilität dieser Ladungsträger in dem Material eine Rolle. Je nachdem, wie diese beiden Faktoren in einem Material zusammenwirken, kann ein Matrixmaterial als Elektronentransportmaterial oder als Lochtransportmaterial dienen.

Dabei findet jeweils auch der Ladungsträgertransport der anderen Ladung statt, es überwiegt jedoch der Transport eines Ladungsträgers. Findet in einem Matrixmaterial kein Ladungsträgertransport statt, wie in einer Ausführungsform der Erfindung in dem ersten Matrixmaterial, so kann das entweder darauf zurückzuführen sein, dass keine Ladungsträger erzeugt werden, dass keine Mobilität der Ladungsträger vorhanden ist oder dass der Elektronentransport und Lochtransport ausgeglichen ist, sodass in der Summe kein Ladungsträgertransport stattfindet.

Die Energieniveaus HOMO und LUMO eines Materials können gemessen werden, um geeignete Materialien für erstes, zweites und drittes Matrixmaterial auszuwählen. So kann das HOMO eines Materials mittels Cyclovoltametrie bestimmt werden. Die Bandlücke, also der energetische Unterschied zwischen HOMO und LUMO kann weiterhin mittels Spektroskopie ermittelt werden, bei der die Wellenlänge des emittierten Lichts gemessen wird und daraus die entstandenen Exzitonen und die Bandlücke berechnet wird. Das Energieniveau des LUMO wird dann aus dem ermittelten HOMO und der Bandlücke berechnet. Das HOMO kann alternativ auch mittels Photoelektronenspektroskopie ermittelt werden.

Die Mobilität von Elektronen und Löchern kann von dem Molekülabstand, also dem mittleren Abstand von Ladungsträgertransportierenden Molekülen in dem jeweiligen Matrixmaterial abhängen. Somit spielt die Konzentration eines Matrixmaterials in der Matrix eine Rolle. Das erste Matrixmaterial, das im Vergleich zu dem zweiten und dritten Matrixmaterial die größte Bandlücke und die geringste Ladungsträgermobilität aufweist, kann dazu dienen, die Konzentration des zweiten und des dritten Matrixmaterials

getrennt voneinander einzustellen. Je nach der gewählten Konzentration des zweiten und dritten Matrixmaterials ändern sich die Abstände zwischen den jeweiligen Molekülen. Der mikroskopische Ladungsträgertransport hängt vom Molekülabstand der Ladungsträgertransportierenden Moleküle in dem jeweiligen Matrixmaterial ab, sodass sich durch die Einstellung der Konzentration die Mobilität von Elektronen und Löchern in der Matrix, die zumindest drei Matrixmaterialien aufweist, getrennt voneinander absolut einstellen lässt.

Nach Miller und Abraham kann die Mobilität folgendermaßen bestimmt werden:

$$\nu_{ij} = \nu_0 \exp[-2\gamma a(\Delta R_{ij}/a)]$$

In diesem Modell wird ein Festkörper schematisch gesehen aus den Plätzen i und j aufgebaut, auf denen sich die Ladungsträger befinden können. Jeder Platz repräsentiert einen lokalisierten Zustand. Der Transport eines Ladungsträgers zwischen den Plätzen i und j wird durch einen Widerstand R_{ij} dargestellt. Die Größe des temperaturabhängigen Widerstands spiegelt dabei den räumlichen Abstand zwischen den Plätzen und die benötigte Aktivierungsenergie für den Übergang wider. Der Parameter γ steht für den Abfall der elektronischen Wellenfunktion der Ladungsträger, a ist der Parameter für den durchschnittlichen Gitterabstand. Die Phononenfrequenz ν_0 gibt die Anzahl der Versuch eines Ladungsträgers aus einem lokalisierten Zustand in einen anderen lokalisierten Zustand zu gelangen an, liegt im Bereich von etwa 10^{13} s^{-1} und berücksichtigt die Stärke der Elektronenphononkopplung.

Die strahlungsemittierende Vorrichtung kann weiterhin eine organische, funktionelle Schicht aufweisen, die aus einer Gruppe ausgewählt ist, die Emissionsschichten, Elektronentransportschichten, Lochtransportschichten, Elektronenblockierschichten, Lochblockierschichten, Lochinjektionsschichten, Elektroneninjektionsschichten und Zwischenschichten umfasst. Mit Zwischenschichten werden Schichten bezeichnet, die zwischen zwei Emissionsschichten angeordnet sind. Je nachdem, was für eine organische, funktionelle Schicht ausgewählt wird, können diese Schichten noch zusätzliche Dotierstoffe enthalten. Die organische, funktionelle Schicht kann eine Emissionsschicht sein und mit einem Emittermaterial dotiert sein. Emittermaterialien können kleine Moleküle oder Polymere umfassen.

Durch Verzicht auf die Dotierung mit Emittermaterialien lassen sich Transport-, Zwischen- und Blockierschichten herstellen.

In einer strahlungsemittierenden Vorrichtung können auch mehrere organische, funktionelle Schichten vorhanden sein, wobei die Schichten unterschiedliche Funktionen oder gleiche Funktionen aufweisen können. Beispielsweise kann eine strahlungsemittierende Vorrichtung eine Abfolge mehrerer funktioneller, organischer Schichten aufweisen, die beispielsweise zusammengesetzt ist aus einer Lochinjektionsschicht, einer Lochtransportschicht, einer ersten Emissionsschicht, einer Zwischenschicht, einer zweiten Emissionsschicht, einer Elektronentransportschicht und einer Elektroneninjektionsschicht. Jede dieser Schichten kann eine Matrix aufweisen, die mindestens ein erstes, ein zweites und ein drittes Matrixmaterial aufweist. Die Matrixmaterialien in den verschiedenen organischen funktionellen Schichten können

in allen Schichten gleich oder unterschiedlich gewählt werden.

Je nachdem, wo sich die Emissionsschicht in dem Schichtstapel der strahlungsemittierenden Vorrichtung befindet, kann dort die Mobilität von Elektronen und Löchern innerhalb dieser Schicht getrennt voneinander optimiert werden, wenn die Emissionsschicht ein erstes, ein zweites und ein drittes Matrixmaterial aufweist. Die Mobilität kann auch über mehrere Schichten hinweg optimiert werden.

Auch wenn die Emissionsschicht, die die drei Matrixmaterialien aufweist, nahe einer Anode oder einer Kathode liegt, kann die Mobilität von Elektronen und Löchern so eingestellt werden, dass das Verhältnis von Löchern und Elektronen in der Emissionsschicht ausgeglichen ist. Je nachdem, welche Ladungsträgersorte eine höhere Beweglichkeit aufweisen soll, kann die Matrix eine höhere Konzentration des jeweiligen Matrixmaterials enthalten. So kann in der Emissionsschicht, unabhängig von der Lage der Emissionsschicht der strahlungsemittierenden Vorrichtung, eine hohe Anzahl an Exzitonen gebildet werden.

Wenn die organische, funktionelle Schicht eine Emissionsschicht mit einem Emittermaterial ist, kann das LUMO des Emittermaterials energetisch niedriger als das LUMO des ersten, zweiten und dritten Matrixmaterials sein und das HOMO des Emittermaterials energetisch höher als das HOMO des ersten, zweiten und dritten Matrixmaterials sein. Somit ist die Bandlücke zwischen HOMO und LUMO des Emittermaterials kleiner als die Bandlücken der drei Matrixmaterialien und liegt zudem energetisch zwischen allen Bandlücken aller

Matrixmaterialien. Ein ambipolarer Ladungstransport in einer Emissionsschicht ist somit möglich.

Die Moleküle des zweiten und dritten Matrixmaterials transportieren bevorzugt nur jeweils eine Ladungsträgersorte, Löcher oder Elektronen, somit bilden sich auf ihnen keine Exzitonen. Damit wird die Lebensdauer der Materialien erhöht, da keine Degradation durch Anregungsenergie stattfinden kann. Zwischen den verschiedenen Molekülen der Matrixmaterialien entstehen angeregte Zustände (Eximere), die ihre Anregungsenergie durch Energietransfer auf die Emittermoleküle übertragen können. Somit wird die Effizienz der strahlungsemittierenden Vorrichtung weiterhin erhöht.

Eine strahlungsemittierende Vorrichtung kann auch mehrere Emissionsschichten aufweisen, beispielsweise um phosphoreszente und fluoreszente Emittermaterialien in einer Vorrichtung zu kombinieren. Dann kann das Einfügen einer Zwischenschicht zwischen den Emissionsschichten notwendig sein, die beispielsweise ambipolare Ladungstransporteigenschaften aufweisen kann. Dies ist durch die Kombination von drei Matrixmaterialien möglich.

Durch Einstellung der Ladungsträgermobilität mit Hilfe der drei Matrixmaterialien ist es möglich, die Lage der Rekombinationszone in einer Emissionsschicht gezielt zu beeinflussen. Die Rekombinationszone kann sich dabei innerhalb einer Schicht oder über mehrere Schichten verteilt befinden. Durch die Einführung der ersten Matrix, die keinen Ladungstransport aufweist, innerhalb einer Emissionsschicht sinkt der absolute Wert der Ladungsträgermobilität. Daraus ergibt sich eine Rekombinationszone, die Zone in der Exzitonen gebildet werden, die von den Rändern einer

emittierenden Schicht zur Mitte hin verschoben wird. Dies erhöht die Effizienz der Vorrichtung, da unter anderem die nicht strahlende Abregung von Exzitonen (Quenching) vermindert wird und mehr Exzitonen in der eigentlichen Emissionsschicht gebildet werden, statt in den angrenzenden Schichten.

Bei der strahlungsemittierenden Vorrichtung kann es sich beispielsweise um eine organische Licht emittierende Vorrichtung handeln. Diese Licht emittierende Vorrichtung kann eine organische, Licht emittierende Diode (OLED) sein.

Die Vorrichtung kann in einer organischen funktionellen Schicht als erstes Matrixmaterial beispielsweise mCP (*m*-Bis(N-carbazolylbenzol)), als zweites Matrixmaterial, das ein Lochtransportmaterial sein kann, TCTA (9H-carbazol,9,9',9''-(1,3,5-Benzoltriyl)tris-(9Cl)), und als drittes Matrixmaterial, das ein Elektronentransportmaterial sein kann, beispielsweise TPBi (1,3,5-Tris(N-Phenylbenzylimidazol-2-ylb) aufweisen. Soll eine Matrix für eine Emissionsschicht bereitgestellt werden, kann als Emittermaterial beispielsweise der gelbe Emitter Rubren (5,6,11,12-Tetraphenylnaphthacen) eingefügt werden.

Es wird weiterhin ein Verfahren zur Herstellung einer strahlungsemittierenden Vorrichtung mit den oben beschriebenen Eigenschaften bereitgestellt. Das Verfahren umfasst die Verfahrensschritte A) Bereitstellen eines Substrats, B) Anordnen einer ersten Elektrode auf dem Substrat, C) Herstellen zumindest einer organischen Schicht auf der ersten Elektrode und D) Anordnen einer zweiten Elektrode auf der zumindest einen organischen Schicht. Im Verfahrensschritt C) wird dabei mindestens ein erstes

Matrixmaterial, ein zweites Matrixmaterial und ein drittes Matrixmaterial gleichzeitig aufgebracht. Das Aufbringen im Verfahrensschritt C) kann beispielsweise durch Aufdampfen (Koevaporation) geschehen. Durch das gleichzeitige Aufbringen kann die Konzentration des jeweiligen Matrixmaterials unabhängig von den anderen Matrixmaterialien bestimmt werden, sodass die Matrixmaterialien in verschiedenen Konzentrationen aufgebracht werden können.

Anhand der Figuren und Ausführungsbeispiele soll die Erfindung näher erläutert werden:

Figur 1 zeigt die schematische Seitenansicht einer strahlungsemittierenden Vorrichtung,

Figur 2 zeigt eine schematische Ansicht der energetischen Zustände der verschiedenen Matrixmaterialien,

Figur 3 zeigt eine schematische Seitenansicht einer strahlungsemittierenden Vorrichtung,

Figur 4 zeigt die Simulation der Mobilität der Ladungsträger in einer Emissionsschicht,

Figur 5 zeigt den schematischen Aufbau zur Herstellung einer Schicht mit mehreren Matrixmaterialien.

Figur 1 zeigt die schematische Seitenansicht einer strahlungsemittierenden Vorrichtung, die ein Substrat 10, eine erste Elektrode 20, eine Emissionsschicht 30 und eine zweite Elektrode 40 umfasst. Die erste Elektrode kann beispielsweise eine Anode und die zweite Elektrode eine Kathode sein. Je nachdem, ob das Substrat und die erste

Elektrode oder die zweite Elektrode transparent ausgeformt sind, kann es sich bei der strahlungsemittierenden Vorrichtung um eine Bottom-emittierende oder eine Top-emittierende Vorrichtung, beispielsweise eine OLED, handeln. Die Emissionsschicht 30 kann ein erstes, ein zweites und ein drittes Matrixmaterial aufweisen und mit einem Emittermaterial dotiert sein.

Figur 2 zeigt die schematische Darstellung der Energieniveaus der jeweiligen Materialien in der Emissionsschicht. Es ist das HOMO und LUMO des ersten Matrixmaterials 30N, des zweiten Matrixmaterials 30B und des dritten Matrixmaterials 30A gezeigt. Das erste Matrixmaterial weist ein HOMO auf, das energetisch niedriger liegt als das HOMO des zweiten Matrixmaterials und des dritten Matrixmaterials. Weiterhin weist das erste Matrixmaterial ein LUMO auf, das energetisch höher liegt als das LUMO des zweiten Matrixmaterials und des dritten Matrixmaterials. Das zweite Matrixmaterial weist ein LUMO auf, das energetisch höher liegt als das LUMO des dritten Matrixmaterials und ein HOMO, das energetisch höher liegt als das HOMO des dritten Matrixmaterials. Damit weist das erste Matrixmaterial geringere Ladungsträgermobilitäten als die beiden anderen Matrixmaterialien auf, das zweite Matrixmaterial kann ein Lochtransportmaterial und das dritte Matrixmaterial ein Elektronentransportmaterial umfassen.

Das Emittermaterial 30E weist ein HOMO und LUMO auf, das die geringste Bandlücke im Vergleich zu den Matrixmaterialien hat und zwischen den LUMOs und den HOMOs der drei Matrixmaterialien liegt.

Rechts in dem Schema ist die Summe der verschiedenen Energieniveaus aufgezeigt. A symbolisiert das Energieniveau,

bei dem der Elektronentransport stattfindet, B symbolisiert das Energieniveau, bei dem Lochtransport stattfindet. d1 und d2 stehen für die energetischen Abstände zwischen den LUMOs des ersten und zweiten Matrixmaterials (d1) und den HOMOs des ersten und dritten Matrixmaterials (d2). d3 symbolisiert die Bandlücke des Emittermaterials. Wird kein Emittermaterial eingesetzt, kann es sich bei der Schicht auch um eine Ladungsträgertransport-, Ladungsträgerinjektions- oder Ladungsträgerblockierschicht handeln. Weiterhin können auch mehrere Emittermaterialien eingesetzt werden.

Figur 3 zeigt die schematische Seitenansicht einer weiteren Ausführungsform der strahlungsemittierenden Vorrichtung, die eine Emissionsschicht 30 aufweist, an die jeweils auf einer Seite eine Elektronentransportschicht 32 und eine Lochtransportschicht 31 angrenzt. Hier handelt es sich bei der ersten Elektrode 20 um eine Anode.
Sowohl die Emissionsschicht 30 als auch die Elektronentransportschicht 32 und die Lochtransportschicht 31 können Matrizen aufweisen, die sich aus drei oder mehr Matrixmaterialien zusammensetzen.

Figur 4 zeigt die Simulation des Ladungsträgertransports in einer OLED, in der eine Emissionsschicht, eine Lochtransportschicht 31 und eine Elektronentransportschicht 32 vorhanden ist. Die x-Achse zeigt die Entfernung der jeweiligen Schicht von der Anode D [nm], die y-Achse zeigt die normierte Rekombinationsrate R_n. Man kann sehen, dass der absolute Wert der Ladungsträgermobilität in der Emissionsschicht 30 im Vergleich zu der Lochtransportschicht 31 und der Elektronentransportschicht 32 sinkt und die Rekombinationszone von den Rändern der Emissionsschicht zur Mitte hin verschoben wird. Das heißt, mit sinkender Mobilität

der Ladungsträger in der Emissionsschicht 30 verringert sich die Rekombination in den angrenzenden Schichten 32 und 31 und verschiebt sich zur Mitte der Emissionsschicht 30.

Bei der Simulation wurden Elektronen- und Lochmobilität in der Emissionsschicht gleichgesetzt, also ein ambipolarer Ladungstransport angenommen. Es wurde ohmsche Injektion angenommen, alle Energiebarrieren zwischen HOMO und LUMO der zwei Schichten betrugen 400 meV für die jeweilige Ladungsträgersorte. In dem Diagramm sind für die verschiedenen Linienformen die jeweiligen Mobilitäten der Ladungsträger in m^2/Vs angegeben, sie bewegen sich zwischen 10^{-8} bis zu 10^{-12}.

Figur 5 zeigt die schematische Seitenansicht eines Aufbaus zur Herstellung der strahlungsemittierenden Vorrichtung. Auf einer Halterung 51 sind beispielhaft vier Verdampfungsquellen 50 aufgebracht, aus denen jeweils Matrixmaterialien und/oder Dotierstoffe auf das Abscheidesubstrat 60 aufgedampft werden können. Um die jeweilige Konzentration des Matrixmaterials und/oder des Dotierstoffs genau bestimmen zu können, wird die Verdampfungsrate über Schichtdickenmonitore 55 gemessen und eingestellt. Bei den Schichtdickenmonitoren kann es sich beispielsweise um Schwingquarze handeln.

Beispielsweise kann mit einem Aufbau gemäß Figur 5 eine Emissionsschicht hergestellt werden, die ein erstes Matrixmaterial enthält, das mCP (*m*-Bis(N-carbazolylbenzol)) umfasst und mit einer Aufdampfrate von 3,8 Å/s aufgebracht wird. Das zweite Matrixmaterial, das Lochtransportmaterial kann TCTA (9H-carbazol,9,9',9''-(1,3,5-Benzoltriyl)tris-(9Cl)) sein und mit einer Aufdampfrate von 8 Å/S aufgebracht werden. Das dritte Matrixmaterial, das Elektronen-

transportmaterial, kann beispielsweise TPBi (1,3,5-Tris(N-Phenylbenzylimidazol-2-ylb) sein und mit einer Aufdampfrate von 8 Å/S aufgebracht werden. Als Emittermaterial kann beispielsweise der gelbe Emitter Rubren (5,6,11,12-Tetraphenylnaphthacen) eingebracht werden und mit einer Aufdampfrate von 0,2 Å/S aufgebracht werden. Damit ergibt sich eine Schicht mit einer Volumenkonzentration von 40% für die Ladungsträgertransportmaterialien und 1% für den Emitter. In Tabelle 1 sind die HOMOs und LUMOs dieser Materialien angegeben:

	HOMO [eV]	LUMO [eV]
mCP	-5,9	-2,3
TCTA	-5,7	-2,3
TPBi	-6,3	-2,8
Rubren	-5,4	-3,2

Tabelle 1

Weitere mögliche Lochtransportmaterialien sind:

NPB N,N'-Bis(Naphthalen-1-yl)-N,N'-bis(phenyl)-Benzidin

TCTA 4,4',4''-Tris(carbazol-9-yl)triphenylamin

CPB 4,4'-Bis(carbazol-9-yl)biphenyl

1T-NATA 4,4',4''-Tris(N-(1-naphthyl)-N-phenyl-amino)triphenylamin

Spiro-TAD 2,2',7,7'-Tetrakis(N,N-diphenylamino)-9,9'-spirobifluoren

Als Elektronentransportmaterialien können weiterhin eingesetzt werden:

TPBi 2,2',2''-(1,3,5-Benzintriyl)-tris(1-phenyl-1-H-benzimidazol)

TAZ	3-(4-Biphenylyl)-4-Phenyl-5-tert-butylphenyl-1,2,4-triazol
Alq_3	Tris(8-Hydroxy-quinolinato)aluminium
BCP	2,9-Dimethyl-4,7-diphenyl-1,10-phenanthrolin
NTAZ	4-(Naphthalen-1-yl)-3,5-diphenyl-4H-1,2,4-triazol
Balq	Bis-(2-methyl-8-quinolinolat)-4-(phenylphenolato)aluminium

Als erstes Matrixmaterial, das im Vergleich zu den anderen Matrixmaterialien die geringste Ladungsträgermobilität aufweist, kann eingesetzt werden:

UGH-2	1,4-Bis(triphenylsilyl)benzol
UGH-3	1,3-Bis(triphenylsilyl)benzol
mCP	1,3-Bis(carbazol-9-Yl)benzol

Mögliche Emittermaterialien sind:

$Ir(ppy)_3$	Tris(2-phenylpyridin)iridum(III)
$Ir(ppy)_2$ (acac)	Bis(2-phenylpyridlin)(acetylacetonat)iridium(II)
BczVBi	4,4'-Bis(9-ethyl-3-carbazovinylen)-1,1'-biphenyl
FirPic	Bis(3,5-Difluoro-2-(2-pyridyl)phenyl-(2-carboxy-pyridyl)iridium(III)
Rubren	Tetraphenylnaphthacen
$Ir(piq)_3$	Tris(1-phenylisoquinolin)iridium(III)

Bei diesen Emittermaterialien handelt es sich um kleine, nicht-polymere Moleküle. Der Einsatz von polymeren Emittermaterialien ist ebenso möglich.

Weitere mögliche Materialien sind:

Bphen	4,7-Diphenyl-1,10-phenanthrolin
DPAVBi	4,4'-Bis(2-(4-(N,N-diphenylamino)phenyl)vinyl)biphenyl
CuPC	Phthalocyanin Kupfer Komplex
S-DPVBi	2,2',7,7'-Tetrakis(2,2-diphenylvinyl)spiro-9,9'-bifluorenCPF
TAPC	1,1-Bis-(4-bis(4-methylphenyl)-aminophenyl)-cyclohexan
TBADN	9,10-Bis(2-naphthyl)-2-t-butylanthracen
TPD	N,N,N',N'-Tetraphenylbenzidin
UGH4	
CPS	

Einige der Elektronen- und Lochtransportmaterialien können auch als erstes Matrixmaterial dienen. Wichtig bei der Zusammenstellung des ersten, zweiten und dritten Matrixmaterials für die Matrix sind das relative Verhältnis der LUMOs und HOMOs der drei kombinierten Materialien und deren Lage zueinander.

Die Matrix kann für phosphoreszente Emitter aufgrund der chemischen Verträglichkeit nicht beliebig gewählt werden. Der rote Emitter Iridium (III)bis(2-methyldibenzo-[f,h]quinoxalin)-acetylacetonat) ist nur in einer NBP-Matrix effizient. NPB ist jedoch ein Lochtransportmaterial. Befindet sich nun anodenseitig noch eine weitere Emitterschicht, wird diese nicht ausreichend mit Elektronen versorgt. Durch Eindotierung eines Elektronentransportmaterials, beispielsweise BCP, können die relativen Transporteigenschaften eingestellt werden. Die Feinabstimmung der Transporteigenschaften erfolgt mit UGH4.

Die in den Figuren und Ausführungsbeispielen gezeigten Ausführungsformen können beliebig variiert werden. Es ist weiterhin zu berücksichtigen, dass sich die Erfindung nicht auf die Beispiele beschränkt, sondern weitere, hier nicht aufgeführte Ausgestaltungen nicht zulässt.

Patentansprüche

1. Strahlungsemittierende Vorrichtung, umfassend
- ein Substrat,
- eine erste Elektrode auf dem Substrat,
- zumindest eine organische, funktionelle Schicht auf der ersten Elektrode, und
- eine zweite Elektrode auf der zumindest einen organischen, funktionellen Schicht,
wobei die zumindest eine organische, funktionelle Schicht mindestens ein erstes Matrixmaterial, ein zweites Matrixmaterial und ein drittes Matrixmaterial aufweist und das erste Matrixmaterial ein Lowest Unoccupied Molecular Orbital (LUMO), das energetisch höher als das LUMO des zweiten Matrixmaterials und das LUMO des dritten Matrixmaterials ist, und ein Highest Occupied Molecular Orbital (HOMO), das energetisch niedriger als das HOMO des zweiten Matrixmaterials und das HOMO des dritten Matrixmaterials ist, aufweist.

2. Strahlungsemittierende Vorrichtung nach dem vorhergehenden Anspruch, wobei das zweite Matrixmaterial ein LUMO, das energetisch höher als das LUMO des dritten Matrixmaterials ist, und ein HOMO, das energetisch höher als das HOMO des dritten Matrixmaterials ist, aufweist.

3. Strahlungsemittierende Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das erste Matrixmaterial eine Ladungsträgermobilität aufweist, die geringer ist als die Ladungsträgermobilitäten des zweiten und dritten Matrixmaterials.

4. Strahlungsemittierende Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das zweite Matrixmaterial ein Lochtransportmaterial umfasst.

5. Strahlungsemittierende Vorrichtung nach einem der vorhergehenden Ansprüche, wobei das dritte Matrixmaterial ein Elektronentransportmaterial umfasst.

6. Strahlungsemittierende Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die organische, funktionelle Schicht ausgewählt ist aus einer Gruppe, die Emissionsschichten, Elektronentransportschichten, Lochtransportschichten, Elektronenblockierschichten, Lochblockierschichten, Lochinjektionsschichten, Elektroneninjektionsschichten und Zwischenschichten umfasst.

7. Strahlungsemittierende Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die organische, funktionelle Schicht eine Emissionsschicht ist und mit einem Emittermaterial dotiert ist.

8. Strahlungsemittierende Vorrichtung nach dem vorhergehenden Anspruch, wobei das LUMO des Emittermaterials energetisch niedriger als das LUMO des ersten, zweiten und dritten Matrixmaterials ist und das HOMO des Emittermaterials energetisch höher als das HOMO des ersten, zweiten und dritten Matrixmaterials ist.

9. Strahlungsemittierende Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Vorrichtung eine organische Licht emittierende Vorrichtung ist.

10. Verfahren zur Herstellung einer strahlungsemittierenden Vorrichtung gemäß den Ansprüchen 1 bis 9, mit den Verfahrensschritten
A) Bereitstellen eines Substrats,
B) Anordnen einer ersten Elektrode auf dem Substrat,
C) Herstellen zumindest einer organischen Schicht auf der ersten Elektrode, und
D) Anordnen einer zweiten Elektrode auf der zumindest

einen organischen Schicht,
wobei im Verfahrensschritt C) mindestens das erste Matrixmaterial, das zweite Matrixmaterial und das dritte Matrixmaterial gleichzeitig aufgebracht werden.

11. Verfahren nach dem vorhergehenden Anspruch, wobei im Verfahrensschritt C) das erste Matrixmaterial, das zweite Matrixmaterial und das dritte Matrixmaterial durch Aufdampfen aufgebracht werden.

Zusammenfassung

Strahlungsemittierende Vorrichtung

Es wird eine strahlungsemittierende Vorrichtung, umfassend ein Substrat, eine erste Elektrode auf dem Substrat, zumindest eine organische, funktionelle Schicht auf der ersten Elektrode und eine zweite Elektrode auf der organischen, funktionellen Schicht angegeben. Die organische, funktionelle Schicht umfasst ein erstes, ein zweites und ein drittes Matrixmaterial, wobei das erste Matrixmaterial eine größere Bandlücke als das zweite und das dritte Matrixmaterial aufweist.

Signifikante Figur 1

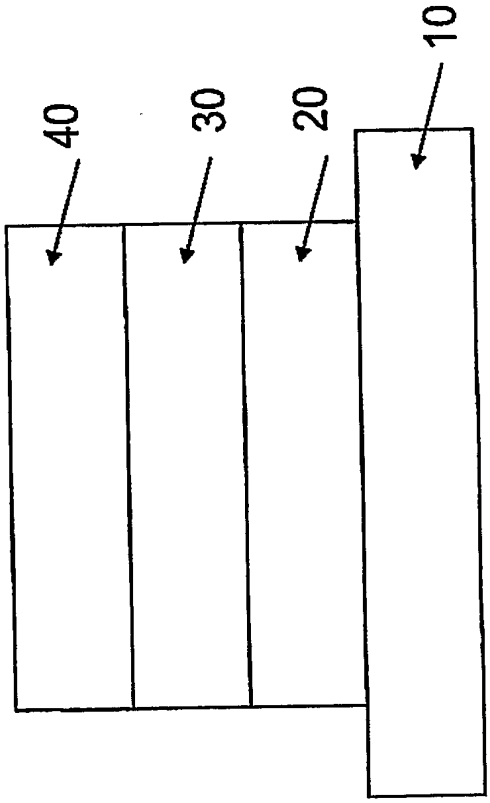


Fig. 1

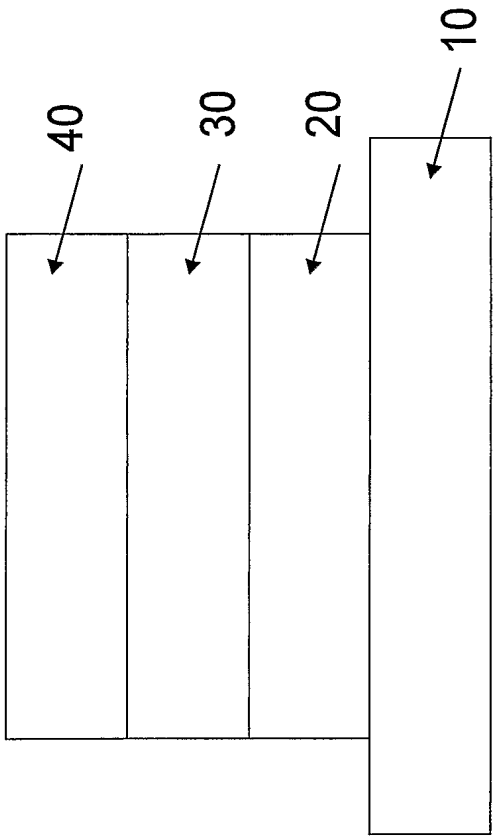


Fig. 1

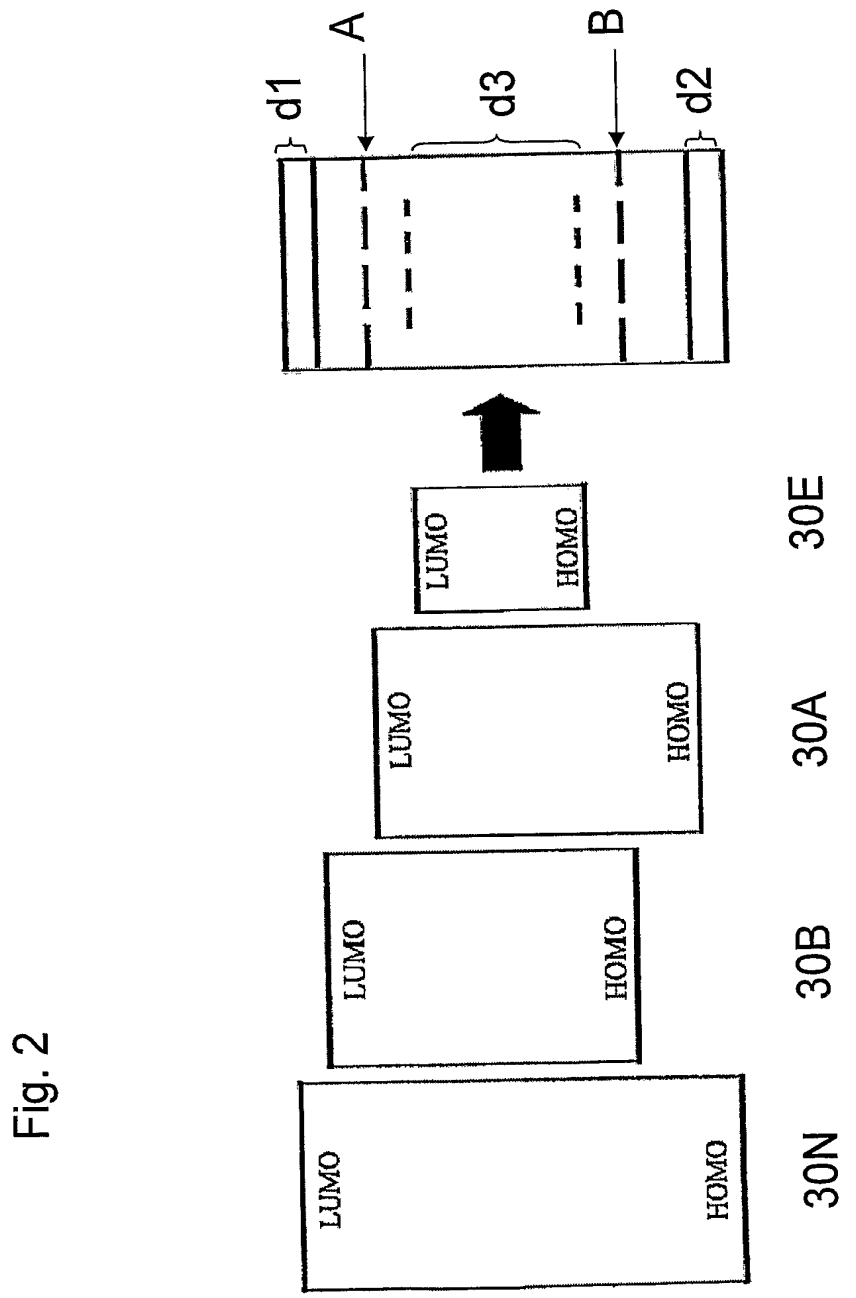


Fig. 2

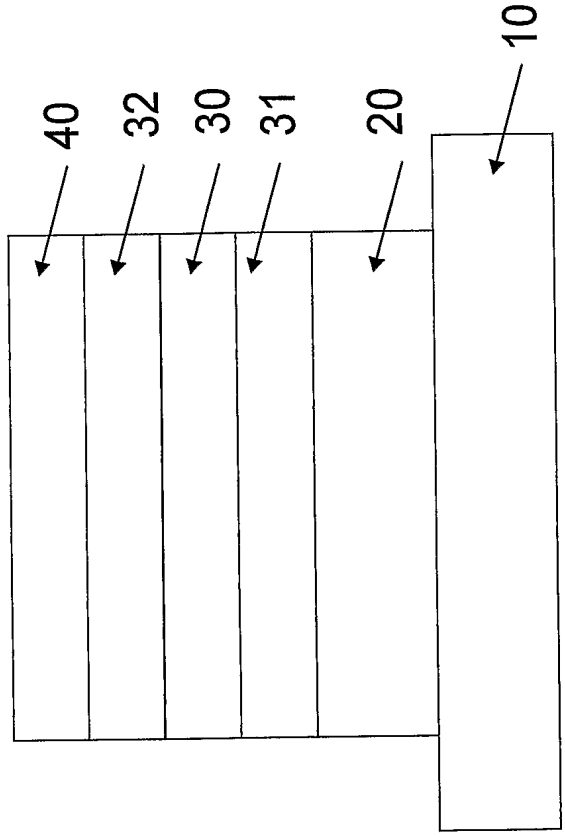


Fig. 3

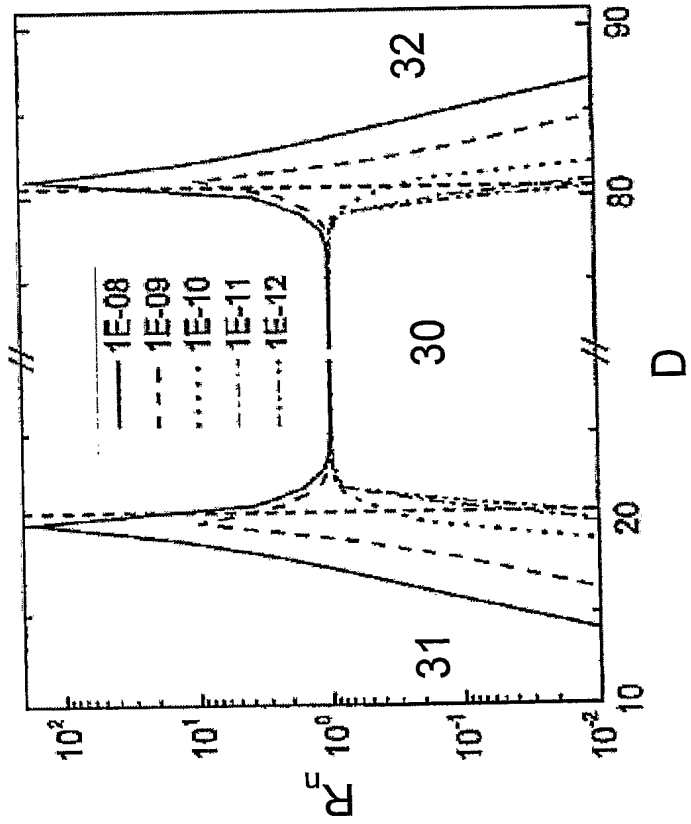

32
30
31
1E-08
1E-09
1E-10
1E-11
1E-12
90
80
20
10
D
10^2
10^1
10^0
10^{-1}
10^{-2}
R_u

Fig. 4

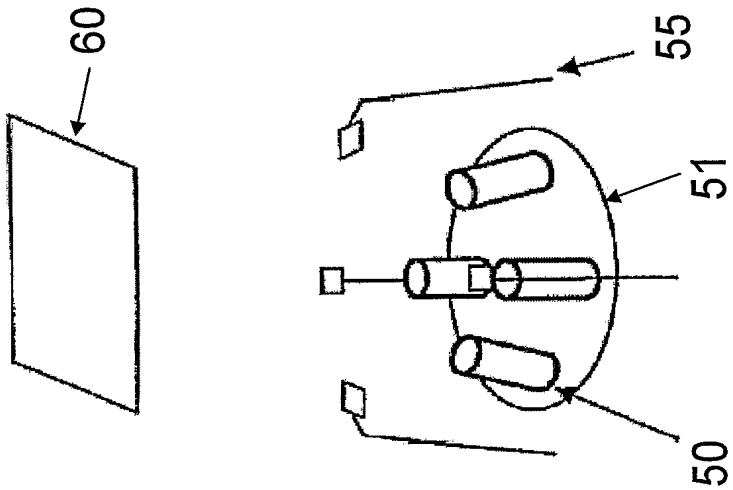


Fig. 5

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Sheet 1 of 2

Complete if Known	
Application Number	12/995,457
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First Named Inventor	Guenter SCHMID
Art Unit	
Examiner Name	
Attorney Docket Number	5367-611PUS

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Document Number Number-Kind-Code [2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-2009/0039294	02-12-2009	Choong et al.	
		US-			
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		DE 10207053396	02-12-2009	Choong et al.		
		WO 2006/038020	04-13-2006	Butler et al.		
		WO 2007/127063	11-08-2007	Kondakova et al.		
		WO 2007/070257	06-21-2007	Kondakov et al.		
		WO 2008/010915	01-24-2008	Ren et al.		
		WO 2008/065975	06-05-2008	Ohsawa et al.		

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		Männing, Bert, "Organische p-I-n Solarzellen" (English translation of relevant pages), Dissertation; Dresden 2004.	
		Miller, Allen et al., "Impurity Conduction at Low Concentrations", Physical Review, Vol. 120, No. 3, Nov. 1, 1960, pp. 745-755.	
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		Tsai, Yung-Cheng et al., "Long-lifetime, high-efficiency white organic light-emitting diodes with mixed host composing double emission layers", Applied Physics Letters, Vol. 89, No. 243521, pp. 1-3.	

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Attorney Docket Number:	5367-611PUS
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4	NPL Documents	20101202112916.pdf	610306 fbd0e50ceb7799dc47eaa71ee767f841ecc6bbdc	no	11
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5	NPL Documents	20101202113010.pdf	5097223 77b89141e5aa5862f61977f5d9d8de115f6fecf3	no	200
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This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Attorney Docket # 5367-611PUS Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re National Phase PCT Application of
Guenter SCHMID et al.
Int'l PCT Serial No.: PCT/DE2009/000701
Int'l Filing Date:: 18 May 2009
For: Electronic Device

Examiner:
Group Art:

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT

S I R:

In compliance with the duty of disclosure under 37 C.F.R. § 1.56 and in accordance with the practice under 37 C.F.R. §§ 1.97 and 1.98, the Examiner's attention is directed to the documents listed on the enclosed form PTO/SB/08A. Copies of the listed non-US documents are also enclosed.

DE 10 2007 053396 corresponds to US 2009/0039294

In accordance with 37 C.F.R §§1.97(g) and (h), the filing of this Information Disclosure Statement should not be construed as a representation that a search has been made or that information cited is, or is considered to be, material to patentability as defined in §1.56(b), or that any cited document listed or attached is (or constitutes) prior art. Unless otherwise indicated, the date of publication indicated for an item is taken from the face of the item and Applicant(s) reserve(s) the right to prove that the date of publication is in fact different.

SDC EX. 1002 - 173/325

It is respectfully requested that the above information be considered by the Examiner and that the copy of the enclosed form PTO/SB/08A be returned indicating that such information has been considered.

If any fees or charges are deemed required at this time in connection with the application, the same may be charged to our Patent and Trademark Office Deposit Account No. 03-2412.

Respectfully submitted,
COHEN PONTANI LIEBERMAN & PAVANE LLP

By /Thomas Langer/
Thomas Langer
Reg. No. 27,264
551 Fifth Avenue, Suite 1210
New York, New York 10176
(212) 687-2770

Dated: December 2, 2010

SDC EX. 1002 - 174/325

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 12/995,457

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	330
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	430
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	220
TOTAL CLAIMS (37 CFR 1.16(i))	15 minus 20 =	*			OR	x 52 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 220 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $270 ($135 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	980

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET

Substitute for Form PTO-1360
(For use with Form PTO/SB/06)

Application Number	Filing Date
12995457	

Applicant(s) Guenter SCHMID

* May be used for additional claims or amendments

CLAIMS	AS FILED		AFTER FIRST AMENDMENT		AFTER SECOND AMENDMENT			*		*		*	
	Indep	Depend	Indep	Depend	Indep	Depend		Indep	Depend	Indep	Depend	Indep	Depend
1	1		1				51						
2		1		1			52						
3		1		1			53						
4		1		1			54						
5		1		1			55						
6		1		1			56						
7		1		1			57						
8		1		1			58						
9		1		1			59						
10		1		1			60						
11		3		1			61						
12		(1)		1			62						
13		(1)		1			63						
14		(1)	1				64						
15		(1)		1			65						
16							66						
17							67						
18							68						
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41							91						
42							92						
43							93						
44							94						
45							95						
46							96						
47							97						
48							98						
49							99						
50							100						
Total Indep	1		2		0								
Total Depend	16	↵	13	↵	0	↵							
Total Claims	17		15		0								

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
12/995,457	Guenter SCHMID	5367-611PUS

27799
COHEN, PONTANI, LIEBERMAN & PAVANE LLP
551 FIFTH AVENUE
SUITE 1210
NEW YORK, NY 10176

INTERNATIONAL APPLICATION NO.	
PCT/DE2009/000701	
I.A. FILING DATE	PRIORITY DATE
05/18/2009	05/30/2008

CONFIRMATION NO. 1889
371 FORMALITIES LETTER

OC000000045111736

Date Mailed: 12/23/2010

NOTIFICATION OF MISSING REQUIREMENTS UNDER 35 U.S.C. 371 IN THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)

The following items have been submitted by the applicant or the IB to the United States Patent and Trademark Office as a Designated Office (37 CFR 1.494):

- Priority Document
- Copy of the International Application filed on 11/30/2010
- English Translation of the IA filed on 11/30/2010
- Copy of the International Search Report filed on 11/30/2010
- Preliminary Amendments filed on 11/30/2010
- Information Disclosure Statements filed on 11/30/2010
- Request for Immediate Examination filed on 11/30/2010
- U.S. Basic National Fees filed on 11/30/2010
- Assignee Statement for PGPUB filed on 11/30/2010
- Priority Documents filed on 11/30/2010

The applicant needs to satisfy supplemental fees problems indicated below.

The following items **MUST** be furnished within the period set forth below in order to complete the requirements for acceptance under 35 U.S.C. 371:

- Oath or declaration of the inventors, in compliance with 37 CFR 1.497(a) and (b), identifying the application by the International application number and international filing date.
- To avoid abandonment, a surcharge (for late submission of filing fee, search fee, examination fee or oath or declaration) as set forth in 37 CFR 1.492(h) of $130 for a non-small entity, must be submitted with the missing items identified in this letter.

SUMMARY OF FEES DUE:

Total additional fees required for this application is $**130** for a Large Entity:
- $**130** Surcharge.

ALL OF THE ITEMS SET FORTH ABOVE MUST BE SUBMITTED WITHIN TWO (2) MONTHS FROM THE DATE OF THIS NOTICE OR BY 32 MONTHS FROM THE PRIORITY DATE FOR THE APPLICATION, WHICHEVER IS LATER. FAILURE TO PROPERLY RESPOND WILL RESULT IN ABANDONMENT.

The time period set above may be extended by filing a petition and fee for extension of time under the provisions of 37 CFR 1.136(a).

FORM PCT/DO/EO/905 (371 Formalities Notice)

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web.
https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

VALERIE A JACKSON

Telephone: (703) 756-1443

From the INTERNATIONAL BUREAU

PCT

SECOND AND SUPPLEMENTARY NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION (TO DESIGNATED OFFICES WHICH APPLY THE 30 MONTH TIME LIMIT UNDER ARTICLE 22(1))

(PCT Rule 47.1(c))

To:

EPPING HERMANN FISCHER
PATENTANWALTSGESELLSCHAFT MBH
Ridlerstrasse 55
80339 München
ALLEMAGNE

EINGANG
Epping · Hermann · Fischer
Patentanwaltsgesellschaft mbH
08. Okt. 2010
Frist:.....

Date of mailing *(day/month/year)*
30 September 2010 (30.09.2010)

Applicant's or agent's file reference
P2008,0612WO

IMPORTANT NOTICE

International application No.
PCT/DE2009/000701

International filing date *(day/month/year)*
18 May 2009 (18.05.2009)

Priority date *(day/month/year)*
30 May 2008 (30.05.2008)

Applicant
OSRAM OPTO SEMICONDUCTORS GMBH et al

1. **ATTENTION**: For any designated Office(s), for which the time limit under Article 22(1), as in force from 1 April 2002 (30 months from the priority date), **does not apply**, please see Form PCT/IB/308(First Notice) issued previously.

2. Notice is hereby given that the following designated Office(s), for which the time limit under Article 22(1), as in force from 1 April 2002, **does apply**, has/have requested that the communication of the international application, as provided for in Article 20, be effected under Rule 93*bis*.1. The International Bureau has effected that communication on the date indicated below:
03 December 2009 (03.12.2009)

AU, AZ, BY, CN, CO, DZ, EP, HU, KG, KP, KR, MD, MK, MY, MZ, NA, NG, PG, RU, SY, TM, US

In accordance with Rule 47.1(c-*bis*)(i), those Offices will accept the present notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

3. The following designated Offices, for which the time limit under Article 22(1), as in force from 1 April 2002, **does apply**, have not requested, as at the time of mailing of the present notice, that the communication of the international application be effected under Rule 93*bis*.1 :

AE, AG, AL, AM, AO, AP, AT, BA, BB, BG, BH, BR, BW, BZ, CA, CH, CR, CU, CZ, DK, DM, DO, EA, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, ID, IL, IN, IS, JP, KE, KM, KN, KZ, LA, LC, LK, LR, LS, LT, LY, MA, ME, MG, MN, MW, MX, NI, NO, NZ, OA, OM, PH, PL, PT, RO, RS, SC, SD, SE, SG, SK, SL, SM, ST, SV, TJ, TN, TR, TT, UA, UZ, VC, VN, ZA, ZM, ZW

In accordance with Rule 47.1(c-*bis*)(ii), those Offices accept the present notice as conclusive evidence that the Contracting State for which that Office acts as a designated Office does not require the furnishing, under Article 22, by the applicant of a copy of the international application.

4. **TIME LIMITS for entry into the national phase**

For the designated or elected Office(s) listed above, the applicable time limit for entering the national phase will, **subject to what is said in the following paragraph**, be **30 MONTHS** from the priority date.

In practice, **time limits other than the 30-month time limit** will continue to apply, for various periods of time, in respect of certain of the designated or elected Office(s) listed above. For **regular updates on the applicable time limits** (30 or 31 months, or other time limit), Office by Office, refer to the *PCT Gazette*, the *PCT Newsletter* and the *PCT Applicant's Guide*, Volume II, National Chapters, all available from WIPO's Internet site, at http://www.wipo.int/pct/en/index.html.

It is the applicant's **sole responsibility** to monitor all these time limits.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. +41 22 338 82 70

Authorized officer
Agnes Wittmann-Regis

e-mail: pt06.pct@wipo.int

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF TRANSMITTAL
OF COPIES OF TRANSLATION
OF THE INTERNATIONAL PRELIMINARY REPORT
ON PATENTABILITY
(CHAPTER I OR CHAPTER II
OF THE PATENT COOPERATION TREATY)

(PCT Rules 44*bis*.3(c) and 72.2)

To:

EPPING HERMANN FISCHER
PATENTANWALTSGESELLSCHAFT MBH
Ridlerstrasse 55
80339 München
ALLEMAGNE

EINGANG
Epping · Hermann · Fischer
Patentanwaltsgesellschaft mbH
21. Dez. 2010
Frist:

Date of mailing *(day/month/year)* 16 December 2010 (16.12.2010)	
Applicant's or agent's file reference P2008,0612WO	IMPORTANT NOTIFICATION
International application No. PCT/DE2009/000701	International filing date *(day/month/year)* 18 May 2009 (18.05.2009)
Applicant OSRAM OPTO SEMICONDUCTORS GMBH et al	

1. **Transmittal of the translation to the applicant.**

☒ The International Bureau transmits herewith a copy of the English translation of the international preliminary report on patentability (Chapter I).

☐ The International Bureau transmits herewith a copy of the English translation of the international preliminary report on patentability (Chapter II).

2. **Transmittal of the copy of the translation to the designated or elected Offices.**

The International Bureau notifies the applicant that copies of that translation have been transmitted to the following designated or elected Offices requiring such translation:

None

The following designated or elected Offices, having waived the requirement for such a transmittal at this time, will receive copies of that translation from the International Bureau only upon their request:

AE, AG, AL, AM, AO, AP, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DK, DM, DO, DZ, EA, EC, EE, EG, EP, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OA, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW

3. **Reminder regarding translation into (one of) the official language(s) of the elected Office(s).**

The applicant is reminded that, where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary report on patentability (Chapter II).

It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned within the applicable time limit (Rule 74.1). See Volume II of the PCT Applicant's Guide for further details.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. +41 22 338 82 70

Authorized officer
Agnes Wittmann-Regis

e-mail: pt06.pct@wipo.int

Form PCT/IB/338 (January 2004)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44*bis*)

Applicant's or agent's file reference P2008,0612WO	**FOR FURTHER ACTION**	See item 4 below
International application No. PCT/DE2009/000701	International filing date *(day/month/year)* 18 May 2009 (18.05.2009)	Priority date *(day/month/year)* 30 May 2008 (30.05.2008)
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237		
Applicant OSRAM OPTO SEMICONDUCTORS GMBH		

1. This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 *bis*.1(a).

2. This REPORT consists of a total of 8 sheets, including this cover sheet.

   In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.

3. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

4. The International Bureau will communicate this report to designated Offices in accordance with Rules 44*bis*.3(c) and 93*bis*.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44*bis* .2).

	Date of issuance of this report 06 December 2010 (06.12.2010)
The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 82 70	Authorized officer Agnes Wittmann-Regis e-mail: pt06.pct@wipo.int

Form PCT/IB/373 (January 2004)

PATENT COOPERATION TREATY

TRANSLATION

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	See form PCT/ISA/210
Applicant's or agent's file reference: P2008,0612WO	FOR FURTHER ACTION: See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/DE2009/000701	18.05.2009	30.05.2008

International Patent Classification (IPC) or both national classification and IPC
H01L51/50

Applicant
OSRAM OPTO SEMICONDUCTORS GMBH

1. This opinion contains indications relating to the following items:

- ☒ Box No. I — Basis of the opinion
- ☐ Box No. II — Priority
- ☐ Box No. III — Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV — Lack of unity of invention
- ☒ Box No. V — Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI — Certain documents cited
- ☐ Box No. VII — Certain defects in the international application
- ☐ Box No. VIII — Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/EP	Date of completion of this opinion	Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/237 (cover sheet) (April 2007)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/DE2009/000701

Box No. I Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of:

☒ the international application in the language in which it was filed

☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:

a. type of material

☐ a sequence listing

☐ table(s) related to the sequence listing

b. format of material

☐ on paper

☐ in electronic form

c. time of filing/furnishing

☐ contained in the international application as filed

☐ filed together with the international application in electronic form

☐ furnished subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table(s) relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/DE2009/000701

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	2, 4, 5, 8-12, 14, 15	YES
	Claims	1, 3, 6, 7, 13	NO
Inventive step (IS)	Claims	2, 4, 5, 8-11, 14, 15	YES
	Claims	1, 3, 6, 7, 12, 13	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims		NO

2. Citations and explanations:

1 Reference is made to the following document:

D1: US 2008/116536 A1 (FORREST STEPHEN R [US] ; YANG FAN [US]) 22 May 2008 (2008-05-22)

2 INDEPENDENT CLAIM 1

2.1 The present application fails to comply with the requirements of PCT Article 33(1) because the subject matter of claim 1 is not novel (PCT Article 33(2)).

Document D1 discloses (the references between parentheses relate to said document):

- an electronic device, comprising
- a substrate (D1: figure 9a, reference sign 110),
- a first electrode (D1: figure 9a, reference sign 120),
- at least one organic, functional layer (D1: paragraphs 19, 81-83, figure 9h, reference signs 953a-d), and
- a second electrode (D1: figure 9h, reference sign 170),
- wherein the at least one organic, functional layer is arranged between the first electrode and

the second electrode, and wherein the at least one organic, functional layer comprises at least a first matrix material (D1: paragraphs 81, 126, figure 9h, reference sign 953a and figure 19, "donor material CuPc"), a second matrix material (D1: paragraphs 81, 126, figure 9h, reference sign 953b and figure 19, "sensitizer SnPc") and a third matrix material (D1: paragraphs 81, 126, figure 9h, reference sign 953c and figure 19, "acceptor material" C_{60}"),

- and the third matrix material has a lowest unoccupied molecular orbital (LUMO) but is energetically lower than the LUMO of the second matrix material and the LUMO of the first matrix material, and wherein the second matrix material has a highest occupied molecular orbital (HOMO) that is energetically higher than the HOMO of the first matrix material and the HOMO of the third matrix material (D1: figure 19).

2.2 Consequently the subject matter of claim 1 is not novel (PCT Article 33(2)).

3 INDEPENDENT CLAIM 14

Document D1 is considered to be the prior art closest to the subject matter of claim 14 and discloses a method for producing an electronic device according to e.g. claim 1 (see D1: paragraphs 81-83, figure 9a-h), wherein the components mentioned in section 2.1 are formed successively by means of conventional method steps.

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No. PCT/DE2009/000701

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Therefore, the subject matter of claim 14 differs from the method known from D1 in that the three matrix materials are applied simultaneously.

The subject matter of claim 14 is therefore novel (PCT Article 33(2)).

The problem addressed in claim 14 of the present invention can therefore be considered that of providing an electronic device having any desired ratio between hole transport and electron transport.

The solution to this problem, as proposed in claim 14 of the present application, involves an inventive step (PCT Article 33(3)) for the following reasons:

According to document D1: paragraphs 26, 81-83, the three matrix materials (D1: figure 9h, reference signs 953a-c) have to be deposited successively in order to be able to form the three matrices of the nanocrystals, figure 9h: reference signs 953a-c. Simultaneous deposition of the three matrix materials would destroy the growth of the crystals. Consequently, a person skilled in the art would not apply the above matrix materials simultaneously.

Claim 15 is dependent on claim 14 and therefore likewise meets the requirements of the PCT in respect of novelty and inventive step.

4 DEPENDENT CLAIMS 3, 6, 7, 12, 13

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No. PCT/DE2009/000701

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Claims 3, 6, 7, 12, 13 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step. The reasons are as follows:

4.1 Document D1: paragraphs 19-21, 81-83, 126, figures 9a-h, 19 also discloses the subject matter of claims 3, 6, 7, 13. Consequently, the subject matter of claims 3, 6, 7, 13 is not novel (PCT Article 33(2)).

4.2 It is known that organic solar cells and organic light-emitting diodes (OLEDs) have the same construction and, by applying a voltage having opposite polarity, it is possible for the solar cells (such as in D1: figure 10) to be operated as an OLED. Consequently, the subject matter of claim 12 cannot be considered to be inventive (PCT Article 33(3)).

5 DEPENDENT CLAIMS 2, 4, 5, 8-11

The combination of features in dependent claims 2, 4, 5, 8-11 is neither known nor obvious from the available prior art. The reasons are as follows:

5.1 In the dye-sensitized solar cell from D1: figure 9h, the first matrix material plays the part of the donor (it can be regarded as a hole transport material), the second matrix material plays the part of the sensitizer, and the third matrix material

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International application No. PCT/DE2009/000701

Box No. V — Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

plays the part of the acceptor (it can be regarded as an electron transport material). From the available prior art it is not obvious to a person skilled in the art to modify these materials in such a way that an electronic device having the band structure or function described in claims 2, 4, 5, 8-11 could be constructed.

Electronic Patent Application Fee Transmittal

Application Number:	12995457
Filing Date:	
Title of Invention:	Electronic Device
First Named Inventor/Applicant Name:	Guenter SCHMID
Filer:	Edward M. Weisz/yolandausher usher
Attorney Docket Number:	5367-611PUS

Filed as Large Entity

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Oath/decl > 30 months from priority date	1617	1	130	130
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**130**

Electronic Acknowledgement Receipt

EFS ID:	9476402
Application Number:	12995457
International Application Number:	
Confirmation Number:	1889
Title of Invention:	Electronic Device
First Named Inventor/Applicant Name:	Guenter SCHMID
Customer Number:	27799
Filer:	Edward M. Weisz/yolandausher usher
Filer Authorized By:	Edward M. Weisz
Attorney Docket Number:	5367-611PUS
Receipt Date:	18-FEB-2011
Filing Date:	
Time Stamp:	13:19:57
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$130
RAM confirmation Number	9280
Deposit Account	032412
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Oath or Declaration filed	20110218132548.pdf	980061 6c5b548a083278767fa7011408bf90c7910f9c6d	no	30
Warnings:					
Information:					
2	Documents submitted with 371 Applications	20110218132641.pdf	311959 498316955a2f8fe7cda8226c1f7aea6005bd6aab	no	10
Warnings:					
Information:					
3	Fee Worksheet (PTO-875)	fee-info.pdf	30022 d9e22b60e4e985d8b26220f9377620d7aceddf17	no	2
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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

P2008,0612 US N / 2091 / 1984 / 2008P16497WOUS (SHS/WB)

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)	Attorney's Docket No. 5367-611PUS

As a below named inventor, I hereby declare that:

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I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

ELECTRONIC DEVICE

the specification of which (check only one item below)

[] is attached hereto

[x] was filed as United States application

Serial No. 12/995,457

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and was amended by Preliminary Amendment filed concurrently with the application.

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PCT	PCT/DE2009/000701	18 May 2009	[] YES	[x] NO
Germany	10 2008 039 361.4	22 August 2008	[x] YES	[] NO
			[] YES	[] NO
			[] YES	[] NO
			[] YES	[] NO
			[] YES	[] NO

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)	Attorney's Docket No. 5367-611PUS
POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) at *Cohen, Pontani, Lieberman & Pavane* to prosecute this application and transact all business in the Patent and Trademark Office connected therewith **Customer number 27799**	
Send correspondence to: *COHEN PONTANI LIEBERMAN & PAVANE LLP* at the address for the following customer Number: **27799**	Direct Telephone calls to: (name and telephone number) Thomas Langer (212) 687-2770
I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.	

201	Primary Citizenship Country::	Germany
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	Country of mailing address::	Germany
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	Country of Residence::	Germany
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205	Primary Citizenship Country::	Germany
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	Country of Residence::	~~Germany~~ Finland
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	City of mailing address::	~~Erlangen~~ Oulu
	Country of mailing address::	~~Germany~~ Finland
	Postal or Zip Code of mailing address::	~~91054~~ 90630

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SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE Dec, 14, 2010	DATE Dec, 14, 2010	DATE
SIGNATURE OF INVENTOR 204	SIGNATURE OF INVENTOR 205	SIGNATURE OF INVENTOR 206
DATE	DATE	DATE
Additional inventor(s) name(s) & address(es) attached? [x] Yes [ ] No		

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207	Primary Citizenship Country::	Germany
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208	Primary Citizenship Country::	Poland
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	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	91056

SIGNATURE OF INVENTOR 207	SIGNATURE OF INVENTOR 208	SIGNATURE OF INVENTOR 209
DATE	DATE	DATE
SIGNATURE OF INVENTOR 210	SIGNATURE OF INVENTOR 211	SIGNATURE OF INVENTOR 212
DATE	DATE	DATE

SDC EX. 1002 - 197/325

P2008,0612 US N / 2091 / 1984 / 2008P16497WOUS (SHS/WB)

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the specification of which (check only one item below)

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) at *Cohen, Pontani, Lieberman & Pavane* to prosecute this application and transact all business in the Patent and Trademark Office connected therewith

Customer number 27799

Send correspondence to: *COHEN PONTANI LIEBERMAN & PAVANE LLP* at the address for the following customer Number: **27799**	Direct Telephone calls to: (name and telephone number) Thomas Langer (212) 687-2770

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SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE	DATE	DATE
SIGNATURE OF INVENTOR 204	SIGNATURE OF INVENTOR 205	SIGNATURE OF INVENTOR 206
DATE 21.12.2010	DATE	DATE
Additional inventor(s) name(s) & address(es) attached? [x] Yes [ ] No		

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SDC EX. 1002 - 202/325

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206	Primary Citizenship Country::	Finland
	Given Name::	~~Ruekka~~ Riikka
	Middle Name::	
	Family Name::	SUHONEN
	City of Residence::	~~Erlangen~~ Oulu
	Country of Residence::	~~Germany~~ Finland
	Street of mailing address::	~~Palmsanlage 4a~~ Välskärintie 6 B6
	City of mailing address::	~~Erlangen~~ Oulu
	Country of mailing address::	~~Germany~~ Finland
	Postal or Zip Code of mailing address::	~~91054~~ 90630

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)		Attorney's Docket No. 5367-611PUS
SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE	DATE	DATE December 15th 2010
SIGNATURE OF INVENTOR 204	SIGNATURE OF INVENTOR 205 Christoph Gaerditz	SIGNATURE OF INVENTOR 206
DATE	DATE 14. December 2010	DATE
Additional inventor(s) name(s) & address(es) attached? [x] Yes [ ] No		

ix S From ID: +49 89 50032999 to: 6440 14:47 12/14/2010 [00:10:38] OK P.007/047

SDC EX. 1002 - 206/325

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)		Attorney's Docket No. 5367-611PUS
207	Primary Citizenship Country::	Germany
	Given Name::	Ulrich
	Middle Name::	
	Family Name::	NIEDERMEIER
	City of Residence::	Leiblfing
	Country of Residence::	Germany
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	City of mailing address::	Leiblfing
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	94339

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)		Attorney's Docket No. 5367-611PUS
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	Given Name::	Fryderyk
	Middle Name::	
	Family Name::	KOZLOWSKI
	City of Residence::	Erlangen
	Country of Residence::	Germany
	Street of mailing address::	Würzburger Ring 33
	City of mailing address::	Erlangen
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	91056

SIGNATURE OF INVENTOR 207	SIGNATURE OF INVENTOR 208	SIGNATURE OF INVENTOR 209
DATE	DATE	DATE
SIGNATURE OF INVENTOR 210	SIGNATURE OF INVENTOR 211	SIGNATURE OF INVENTOR 212
DATE	DATE	DATE

SDC EX. 1002 - 207/325

P2008,0612 US N / 2091 / 1984 / 2008P16497WOUS (SHS/WB)

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)	Attorney's Docket No. 5367-611PUS

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

ELECTRONIC DEVICE

the specification of which (check only one item below)

[] is attached hereto

[x] was filed as United States application

Serial No. 12/995,457

on November 30, 2010

and was amended by Preliminary Amendment filed concurrently with the application.

[] was filed as PCT international application

Number PCT/DE2009/000701

on 18 May 2009

and was amended under PCT Article 19

on _ (if applicable).

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Germany	10 2008 025 920.9	30 May 2008	[x] YES	[] NO
PCT	PCT/DE2009/000701	18 May 2009	[] YES	[x] NO
Germany	10 2008 039 361.4	22 August 2008	[x] YES	[] NO
			[] YES	[] NO
			[] YES	[] NO
			[] YES	[] NO
			[] YES	[] NO

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)	Attorney's Docket No. 5367-611PUS

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) at *Cohen, Pontani, Lieberman & Pavane* to prosecute this application and transact all business in the Patent and Trademark Office connected therewith

Customer number 27799

Send correspondence to: *COHEN PONTANI LIEBERMAN & PAVANE LLP* at the address for the following customer Number: **27799**	Direct Telephone calls to: (name and telephone number) Thomas Langer (212) 687-2770

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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	Middle Name::	
	Family Name::	SCHMID
	City of Residence::	Hemhofen
	Country of Residence::	Germany
	Street of mailing address::	Lange Strasse 13
	City of mailing address::	Hemhofen
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	91334

202	Primary Citizenship Country::	Germany
	Given Name::	Ralf
	Middle Name::	
	Family Name::	KRAUSE
	City of Residence::	Erlangen
	Country of Residence::	Germany
	Street of mailing address::	Ratiborer Str. 10
	City of mailing address::	Erlangen
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	91058

SDC EX. 1002 - 209/325

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)		Attorney's Docket No. 5367-611PUS
203	Primary Citizenship Country::	Germany
	Given Name::	Stefan
	Middle Name::	
	Family Name::	SEIDEL
	City of Residence::	Nittendorf
	Country of Residence::	Germany
	Street of mailing address::	Bernsteinstraße 12
	City of mailing address::	Nittendorf
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	93152

204	Primary Citizenship Country::	Germany
	Given Name::	Oliver
	Middle Name::	
	Family Name::	WEISS
	City of Residence::	Dossenheim
	Country of Residence::	Germany
	Street of mailing address::	Schulstrasse 1
	City of mailing address::	Dossenheim
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	69221

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)		Attorney's Docket No. 5367-611PUS
205	Primary Citizenship Country::	Germany
	Given Name::	Christoph
	Middle Name::	
	Family Name::	GAERDITZ
	City of Residence::	Regensburg
	Country of Residence::	Germany
	Street of mailing address::	Bischof-Konrad-Str. 2
	City of mailing address::	Regensburg
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	93051

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	Country of mailing address::	~~Germany~~ Finland
	Postal or Zip Code of mailing address::	~~91054~~ 90630

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)		Attorney's Docket No. 5367-611PUS
SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE	DATE	DATE
SIGNATURE OF INVENTOR 204	SIGNATURE OF INVENTOR 205	SIGNATURE OF INVENTOR 206
DATE	DATE	DATE 15.02.2011
Additional inventor(s) name(s) & address(es) attached? [x] Yes [ ] No		

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)		Attorney's Docket No. 5367-611PUS
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	Country of Residence::	Germany
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	City of mailing address::	Leiblfing
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	94339

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	Given Name::	Fryderyk
	Middle Name::	
	Family Name::	KOZLOWSKI
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	Country of Residence::	Germany
	Street of mailing address::	Würzburger Ring 33
	City of mailing address::	Erlangen
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	91056

SIGNATURE OF INVENTOR 207	SIGNATURE OF INVENTOR 208	SIGNATURE OF INVENTOR 209
DATE	DATE	DATE
SIGNATURE OF INVENTOR 210	SIGNATURE OF INVENTOR 211	SIGNATURE OF INVENTOR 212
DATE	DATE	DATE

SDC EX. 1002 - 212/325

P2008,0612 US N / 2091 / 1984 / 2008P16497WOUS (SHS/WB)

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)	Attorney's Docket No. 5367-611PUS

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ELECTRONIC DEVICE

the specification of which (check only one item below)

[] is attached hereto

[x] was filed as United States application

Serial No. 12/995,457

on November 30, 2010

and was amended by Preliminary Amendment filed concurrently with the application.

[] was filed as PCT international application

Number PCT/DE2009/000701

on 18 May 2009

and was amended under PCT Article 19

on _ (if applicable).

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Germany	10 2008 039 361.4	22 August 2008	[x] YES	[] NO
			[] YES	[] NO
			[] YES	[] NO
			[] YES	[] NO
			[] YES	[] NO

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)	Attorney's Docket No. 5367-611PUS

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) at *Cohen, Pontani, Lieberman & Pavane* to prosecute this application and transact all business in the Patent and Trademark Office connected therewith

Customer number 27799

Send correspondence to: *COHEN PONTANI LIEBERMAN & PAVANE LLP* at the address for the following customer Number: **27799**	Direct Telephone calls to: (name and telephone number) Thomas Langer (212) 687-2770

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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	Middle Name::	
	Family Name::	SCHMID
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	Country of Residence::	Germany
	Street of mailing address::	Lange Strasse 13
	City of mailing address::	Hemhofen
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	91334

202	Primary Citizenship Country::	Germany
	Given Name::	Ralf
	Middle Name::	
	Family Name::	KRAUSE
	City of Residence::	Erlangen
	Country of Residence::	Germany
	Street of mailing address::	Ratiborer Str. 10
	City of mailing address::	Erlangen
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	91058

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)		Attorney's Docket No. 5367-611PUS
203	Primary Citizenship Country::	Germany
	Given Name::	Stefan
	Middle Name::	
	Family Name::	SEIDEL
	City of Residence::	Nittendorf
	Country of Residence::	Germany
	Street of mailing address::	Bernsteinstraße 12
	City of mailing address::	Nittendorf
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	93152

204	Primary Citizenship Country::	Germany
	Given Name::	Oliver
	Middle Name::	
	Family Name::	WEISS
	City of Residence::	Dossenheim
	Country of Residence::	Germany
	Street of mailing address::	Schulstrasse 1
	City of mailing address::	Dossenheim
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	69221

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	Given Name::	Christoph
	Middle Name::	
	Family Name::	GAERDITZ
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	Country of Residence::	Germany
	Street of mailing address::	Bischof-Konrad-Str. 2
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	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	93051

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	Postal or Zip Code of mailing address::	~~91054~~ 90630

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)		Attorney's Docket No. 5367-611PUS
SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE	DATE	DATE
SIGNATURE OF INVENTOR 204	SIGNATURE OF INVENTOR 205	SIGNATURE OF INVENTOR 206
DATE	DATE	DATE
Additional inventor(s) name(s) & address(es) attached? [x] Yes [ ] No		

SDC EX. 1002 - 216/325

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)		Attorney's Docket No. 5367-611PUS
207	Primary Citizenship Country::	Germany
	Given Name::	Ulrich
	Middle Name::	
	Family Name::	NIEDERMEIER
	City of Residence::	Leiblfing
	Country of Residence::	Germany
	Street of mailing address::	Oberwalting 61
	City of mailing address::	Leiblfing
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	94339

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)		Attorney's Docket No. 5367-611PUS
208	Primary Citizenship Country::	Poland
	Given Name::	Fryderyk
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	Family Name::	KOZLOWSKI
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	Country of Residence::	Germany
	Street of mailing address::	Würzburger Ring 33
	City of mailing address::	Erlangen
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	91056

SIGNATURE OF INVENTOR 207 Ulrich Niedermeier	SIGNATURE OF INVENTOR 208	SIGNATURE OF INVENTOR 209
DATE December 15, 2010	DATE	DATE
SIGNATURE OF INVENTOR 210	SIGNATURE OF INVENTOR 211	SIGNATURE OF INVENTOR 212
DATE	DATE	DATE

SDC EX. 1002 - 217/325

P2008,0612 US N / 2091 / 1984 / 2008P16497WOUS (SHS/WB)

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)	Attorney's Docket No. 5367-611PUS

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	City of mailing address::	Hemhofen
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	Middle Name::	
	Family Name::	KRAUSE
	City of Residence::	Erlangen
	Country of Residence::	Germany
	Street of mailing address::	Ratiborer Str. 10
	City of mailing address::	Erlangen
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	Country of Residence::	Germany
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	City of mailing address::	Dossenheim
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SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE	DATE	DATE
SIGNATURE OF INVENTOR 204	SIGNATURE OF INVENTOR 205	SIGNATURE OF INVENTOR 206
DATE	DATE	DATE
Additional inventor(s) name(s) & address(es) attached? [x] Yes [ ] No		

SDC EX. 1002 - 221/325

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)		Attorney's Docket No. 5367-611PUS
207	Primary Citizenship Country::	Germany
	Given Name::	Ulrich
	Middle Name::	
	Family Name::	NIEDERMEIER
	City of Residence::	Leiblfing
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	Country of Residence::	Germany
	Street of mailing address::	Würzburger Ring 33
	City of mailing address::	Erlangen
	Country of mailing address::	Germany
	Postal or Zip Code of mailing address::	91056

SIGNATURE OF INVENTOR 207	SIGNATURE OF INVENTOR 208	SIGNATURE OF INVENTOR 209
DATE	DATE 22.12.2010	DATE
SIGNATURE OF INVENTOR 210	SIGNATURE OF INVENTOR 211	SIGNATURE OF INVENTOR 212
DATE	DATE	DATE

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
12/995,457	Guenter Schmid	5367-611PUS

27799
Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172

INTERNATIONAL APPLICATION NO.	
PCT/DE2009/000701	
I.A. FILING DATE	PRIORITY DATE
05/18/2009	05/30/2008

CONFIRMATION NO. 1889
371 ACCEPTANCE LETTER

OC000000049389223

Date Mailed: 08/19/2011

NOTICE OF ACCEPTANCE OF APPLICATION UNDER 35 U.S.C 371 AND 37 CFR 1.495

The applicant is hereby advised that the United States Patent and Trademark Office in its capacity as a Designated / Elected Office (37 CFR 1.495), has determined that the above identified international application has met the requirements of 35 U.S.C. 371, and is ACCEPTED for national patentability examination in the United States Patent and Trademark Office.

The United States Application Number assigned to the application is shown above and the relevant dates are:

02/18/2011	02/18/2011
DATE OF RECEIPT OF 35 U.S.C. 371(c)(1), (c)(2) and (c)(4) REQUIREMENTS	DATE OF COMPLETION OF ALL 35 U.S.C. 371 REQUIREMENTS

A Filing Receipt (PTO-103X) will be issued for the present application in due course. **THE DATE APPEARING ON THE FILING RECEIPT AS THE " FILING DATE" IS THE DATE ON WHICH THE LAST OF THE 35 U.S.C. 371 (c)(1), (c)(2) and (c)(4) REQUIREMENTS HAS BEEN RECEIVED IN THE OFFICE. THIS DATE IS SHOWN ABOVE.** *The filing date of the above identified application is the international filing date of the international application (Article 11(3) and 35 U.S.C. 363).* Once the Filing Receipt has been received, send all correspondence to the Group Art Unit designated thereon.

The following items have been received:

- Copy of the International Application filed on 11/30/2010
- English Translation of the IA filed on 11/30/2010
- Copy of the International Search Report filed on 11/30/2010
- Preliminary Amendments filed on 11/30/2010
- Information Disclosure Statements filed on 11/30/2010
- Oath or Declaration filed on 02/18/2011
- Request for Immediate Examination filed on 11/30/2010
- U.S. Basic National Fees filed on 11/30/2010
- Assignee Statement for PGPUB filed on 11/30/2010
- Priority Documents filed on 11/30/2010

FORM PCT/DO/EO/903 (371 Acceptance Notice)

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

VALERIE A JACKSON

Telephone: (703) 756-1443

FORM PCT/DO/EO/903 (371 Acceptance Notice)

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/995,457	02/18/2011		1110	5367-611PUS	15	2

CONFIRMATION NO. 1889

27799
Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172

FILING RECEIPT

OC000000049389222

Date Mailed: 08/19/2011

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Guenter Schmid, Hemhofen, GERMANY;
Ralf Krause, Erlangen, GERMANY;
Stefan Seidel, Nittendorf, GERMANY;
Oliver Weiss, Dossenheim, GERMANY;
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Fryderyk Kozlowski, Erlangen, GERMANY;

Assignment For Published Patent Application

OSRAM Opto Semiconductors GmbH, Regensburg, GERMANY

Power of Attorney: The patent practitioners associated with Customer Number 27799

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/DE2009/000701 05/18/2009

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)
GERMANY 10 2008 025 920.9 05/30/2008
GERMANY 10 2008 039 361.4 08/22/2008

If Required, Foreign Filing License Granted: 08/17/2011

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/995,457**

Projected Publication Date: 12/01/2011

SDC EX. 1002 - 225/325

Non-Publication Request: No

Early Publication Request: No

Title

Electronic Device

Preliminary Class

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where

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This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

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NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 12/995,457

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	330
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	430
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	220
TOTAL CLAIMS (37 CFR 1.16(i))	15 minus 20 =	*			OR	x 52 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 220 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $270 ($135 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	980

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/995,457	02/18/2011	Guenter Schmid	5367-611PUS

CONFIRMATION NO. 1889

27799
Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172

PUBLICATION NOTICE



Title: Electronic Device

Publication No.US-2011-0291080-A1
Publication Date:12/01/2011

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,457	02/18/2011	Guenter Schmid	5367-611PUS-299873.000	1889

27799 7590 04/04/2013

Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172

EXAMINER	
HO, ANTHONY	

ART UNIT	PAPER NUMBER
2815	

NOTIFICATION DATE	DELIVERY MODE
04/04/2013	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentsecretary@cozen.com
patentdocket@cozen.com
patentsorter@cozen.com

Office Action Summary	Application No.	Applicant(s)	
	12/995,457	SCHMID ET AL.	
	Examiner	Art Unit	
	ANTHONY HO	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 November 2010*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *1-15* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1,3,6,7,12 and 13* is/are rejected.

8)☒ Claim(s) *2,4,5,8-11,14 and 15* is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *11/30/2010, 12/2/2010*.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Information Disclosure Statement

2. The information disclosure statement (IDS) submitted on November 30, 2010 was filed after the mailing date of the instant application on November 30, 2010. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

3. The information disclosure statement (IDS) submitted on December 2, 2010 was filed after the mailing date of the instant application on November 30, 2010. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Claim Objections

4. Claim 15 is objected to because of the following informalities: Claim 15 recites a method according to claim 1, however claim 1 pertains to an electronic device while claim 15 pertains to a method. Appropriate correction is required.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

6. Claims 1, 3, 6, 7, 12, and 13 are rejected under 35 U.S.C. 102(e) as being anticipated by Forrest et al (US PUB 2008/0116536).

In re claim 1, Forrest et al discloses an electronic device, comprising: a substrate (i.e. Figure 9a, reference sign 110), a first electrode (i.e. Figure 9a, reference sign 120), at least one organic, functional layer (i.e. paragraphs 0019, 0081-0083, Figure 9h, reference signs 953a-d), and a second electrode (i.e. Figure 9h, reference sign 170), wherein the at least one organic functional layer is located between the first electrode and the second electrode, and wherein the at least one organic functional layer has at least a first matrix material (i.e. paragraphs 0081, 0126, Figure 9h, reference sign 953a and Figure 19, “donor material CuPc”), a second matrix material (i.e. paragraphs 0081, 0126, Figure 9h, reference sign 953b and Figure 19, “sensitizer SnPc”), and a third matrix material (i.e. paragraphs 0081, 0126, Figure 9h, reference sign 953c and Figure 19, “acceptor material C_{60}”), and the third matrix material has a Lowest Unoccupied Molecular Orbital (LUM0), which is energetically lower than the LUMO of the second matrix material and the LUMO of the first matrix material, and wherein the second

matrix material has a Highest Occupied Molecular Orbital (HOMO), which is energetically higher than the HOMO of the first matrix material and the HOMO of the third matrix material (i.e. Figure 19).

In re claim 3, Forrest et al discloses wherein the second matrix material has a LUMO which is energetically higher than the LUMO of the third matrix material, and a HOMO which is energetically higher than the HOMO of the third matrix material (i.e. paragraphs 0019-0021, 0081-0083, 0126, Figures 9a-9h, 19).

In re claim 6, Forrest et al discloses wherein the third matrix material comprises an electron transport material (i.e. paragraphs 0019-0021, 0081-0083, 0126, Figures 9a-9h, 19).

In re claim 7, the recitation "wherein the organic functional layer is selected from a group which comprises emission layers, electron transport layers, hole transport layers, electron blocking layers, hole blocking layers, hole injection layers, electron injection layers, and intermediate layers" in the claim specifies an intended use or field of use and is treated as nonlimiting since it has been held that in device claims, intended use must result in a structural difference between the claim invention and the prior art in order to patentably distinguish the claim invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. *In re Casey*, 152 USPQ 235 (CCPA 1967); In re Otto, 136 USPQ 458, 459 (CCPA 1963). A claim containing a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art

apparatus if the prior art apparatus teaches all the structural limitations of the claim. *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987).

In re claim 12, the recitation "which is constructed as a radiation-emitting device" in the claim specifies an intended use or field of use and is treated as nonlimiting since it has been held that in device claims, intended use must result in a structural difference between the claim invention and the prior art in order to patentably distinguish the claim invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. *In re Casey*, 152 USPQ 235 (CCPA 1967); In re Otto, 136 USPQ 458, 459 (CCPA 1963). A claim containing a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior art apparatus if the prior art apparatus teaches all the structural limitations of the claim. *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987).

In re claim 13, the recitation "wherein the device is selected from a group which comprises an organic light-emitting device, a solar cell, and a transistor" in the claim specifies an intended use or field of use and is treated as nonlimiting since it has been held that in device claims, intended use must result in a structural difference between the claim invention and the prior art in order to patentably distinguish the claim invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. *In re Casey*, 152 USPQ 235 (CCPA 1967); In re Otto, 136 USPQ 458, 459 (CCPA 1963). A claim containing a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate

the claimed apparatus from a prior art apparatus if the prior art apparatus teaches all the structural limitations of the claim. *Ex parte Masham*, 2 USPQ2d 1647 (Bd. Pat. App. & Inter. 1987).

Allowable Subject Matter

7. Claims 2, 4, 5, 8-11, 14, and 15 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANTHONY HO whose telephone number is (571)270-1432. The examiner can normally be reached on Monday to Friday: 1:30PM - 10:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Anthony Ho/
Primary Examiner, Art Unit 2815

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995457	SCHMID ET AL.
	Examiner	Art Unit
	ANTHONY HO	2815

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
257	40, e51.001	3/22/2013	AH

SEARCH NOTES		
Search Notes	Date	Examiner
consult related PCT case	3/22/2013	AH
conduct EAST search	3/22/2013	AH

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

PTO/SB/08a (04-03)
Approved for use through 04/30/2003. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number

Substitute for Form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 2

Complete if Known	
Application Number	12/995,457
Filing Date	
First Named Inventor	Guenter SCHMID
Art Unit	
Examiner Name	
Attorney Docket Number	5367-611PUS

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Document Number Number-Kind-Code [2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-2009/0039294	02-12-2009	Choong et al.	
		US-			
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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Foreign Patent Document Country Code [3]- Number [4]-Kind-Code [5] (if known	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T [6]
		DE 10207053396	02-12-2009	Choong et al.		
		WO 2006/038020	04-13-2006	Butler et al.		
		WO 2007/127063	11-08-2007	Kondakova et al.		
		WO 2007/070257	06-21-2007	Kondakov et al.		
		WO 2008/010915	01-24-2008	Ren et al.		
		WO 2008/065975	06-05-2008	Ohsawa et al.		

Examiner Signature	/Anthony Ho/	Date Considered	03/22/2013

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.H./
SDC EX. 1002 - 239/325

PTO/SB/08a (04-03)
Approved for use through 04/30/2003. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Substitute for Form 1449/PTO		Complete if Known
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)	Application Number	12/995,457
	Filing Date	
	First Named Inventor	Guenter SCHMID
	Art Unit	
	Examiner Name	
Sheet 2 of 2	Attorney Docket Number	5367-611PUS

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No. [1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
		Männing, Bert, "Organische p-I-n Solarzellen" (English translation of relevant pages), Dissertation; Dresden 2004.	
		Miller, Allen et al., "Impurity Conduction at Low Concentrations", Physical Review, Vol. 120, No. 3, Nov. 1, 1960, pp. 745-755.	
		Schwartz, Gregor et al., "High efficiency white organic light emitting diodes combining fluorescent and phosphorescent emitter systems", Organic Optoelectronics and Photonics II, Proc. of SPIE, Vol. 6192, No. 61920Q, 2006, pp. 1-6.	
		Tsai, Yung-Cheng et al., "Long-lifetime, high-efficiency white organic light-emitting diodes with mixed host composing double emission layers", Applied Physics Letters, Vol. 89, No. 243521, pp. 1-3.	

Examiner Signature	/Anthony Ho/	Date Considered	03/22/2013

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	4	(20080116536|20020101154|20060068223|20080074038).pn.	US-PGPUB; USPAT	OR	OFF	2013/03/22 16:31
S1	8245	257/40.ccls.	US-PGPUB; USPAT	OR	OFF	2013/03/21 18:06
S2	598	257/e51.001.ccls.	US-PGPUB; USPAT	OR	OFF	2013/03/21 18:06
S3	56	(guenter same schmid).in.	US-PGPUB; USPAT	OR	OFF	2013/03/21 18:07
S4	31	(ralf same krause).in.	US-PGPUB; USPAT	OR	OFF	2013/03/21 18:07
S5	8	(stefan same seidel).in.	US-PGPUB; USPAT	OR	OFF	2013/03/21 18:07
S6	21	(oliver same weiss).in.	US-PGPUB; USPAT	OR	OFF	2013/03/21 18:07
S7	8	(christoph same gaerditz).in.	US-PGPUB; USPAT	OR	OFF	2013/03/21 18:07
S8	0	(ruekka same suhonen).in.	US-PGPUB; USPAT	OR	OFF	2013/03/21 18:07
S9	26	(ulrich same niedermeier).in.	US-PGPUB; USPAT	OR	OFF	2013/03/21 18:07
S10	2	(fryderyk same kozlowski).in.	US-PGPUB; USPAT	OR	OFF	2013/03/21 18:08
S11	1108	(osram same opto same semiconductors).as.	US-PGPUB; USPAT	OR	OFF	2013/03/21 18:08
S12	1	("20090039294").PN.	US-PGPUB; USPAT	OR	OFF	2013/03/21 18:08

EAST Search History (Interference)

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PTO/SB/08a (04-03)
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Substitute for Form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 2

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	Guenter SCHMID
Art Unit	
Examiner Name	
Attorney Docket No.	5367-611PUS

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Document Number Number-Kind-Code [2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-2008/0116536	05-22-2008	Forrest et al.	
		US-2002/0101154	08-01-2002	Seo et al.	
		US-2006/0068223	03-30-2006	Nariyuki et al.	
		US-2008/0074038	03-27-2008	Kim et al.	
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Examiner Signature	/Anthony Ho/	Date Considered	03/22/2013

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	First Named Inventor	Guenter SCHMID
	Art Unit	
	Examiner Name	
Sheet 2 of 2	Attorney Docket No.	5367-611PUS

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Examiner Initials*	Cite No. [1]	Foreign Patent Document: Country Code[3]- Number[4]- Kind-Code [5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
		WO 02/074015	09-19-2002	Univ. Princeton, et al.		

Examiner Signature	/Anthony Ho/	Date Considered	03/22/2013

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ALL DELETIONS IGNORED UNLESS EXPLAINED WHERE LINED THROUGH. /A.H./

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995457	SCHMID ET AL.
	Examiner	Art Unit
	ANTHONY HO	2815

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/22/2013								
	1	✓								
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	4	O								
	5	O								
	6	✓								
	7	✓								
	8	O								
	9	O								
	10	O								
	11	O								
	12	✓								
	13	✓								
	14	O								
	15	O								

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Attorney Docket # 5367-611PUS - 299873.000 Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of
Guenter SCHMID et al.
Serial No.: 12/995,457
Filed: February 18, 2011
For: Electronic Device

Examiner: HO, Anthony
Group Art: 2815

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT

S I R:

In compliance with the duty of disclosure under 37 C.F.R. §1.56 and in accordance with the practice under 37 C.F.R. §§1.97 and 1.98, the Examiner's attention is directed to the documents listed on the enclosed Form PTO/SB/08A. Copies of the listed non-US documents are also enclosed.

Enclosed is a copy of an English Translation of an Office Action dated December 20, 2012 issued in the corresponding Taiwanese Patent Application No. 098116998. References not appearing on the attached Form PTO/SB/08A were submitted to the USPTO in a previously filed IDS.

This information is being submitted subsequent to the later of three months after the filing date of the present application or the mailing of the first Office Action on the merits, but before the mailing of a final Action or the Notice of Allowance.

SDC EX. 1002 - 245/325

In accordance with 37 C.F.R §§1.97(g) and (h), the filing of this Information Disclosure Statement should not be construed as a representation that a search has been made or that information cited is, or is considered to be, material to patentability as defined in §1.56(b), or that any cited document listed or attached is (or constitutes) prior art. Unless otherwise indicated, the date of publication indicated for an item is taken from the face of the item and Applicants reserve the right to prove that the date of publication is in fact different.

Submitted herewith is the amount of $180 in payment of the required fee under 37 C.F.R. § 1.17(p). Any additional fees or charges required at this time may be charged to our U.S. patent and Trademark Office Deposit Account No. 503111.

It is respectfully requested that the above information be considered by the Examiner and that a copy of the enclosed Form PTO/SB/08a be returned indicating that such information has been considered.

Respectfully submitted,
COZEN O'CONNOR

By /Alphonso A. Collins/
Alphonso A. Collins
Reg. No. 43,559
277 Park Avenue
New York, New York 10172
(212) 883-4900

Dated: April 17, 2013

SDC EX. 1002 - 246/325

PTO/SB/08A (04-03)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 1

Complete if Known	
Application Number	12/995,457
Filing Date	February 18, 2011
First Named Inventor	Guenter SCHMID
Art Unit	2815
Examiner Name	HO, Anthony
Attorney Docket	5367-611PUS - 299873.000

U.S. PATENT DOCUMENTS

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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Foreign Patent Document Country Code[3]- Number[4]- Kind-Code [5] (if known	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
		TW 200746898	12-16-2007	Kondakova et al.		Abs.
		TW 543342	07-21-2003	Seo et al.		Abs.

Examiner Signature		Date Considered	

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Electronic Patent Application Fee Transmittal

Application Number:	12995457
Filing Date:	18-Feb-2011
Title of Invention:	Electronic Device
First Named Inventor/Applicant Name:	Guenter Schmid
Filer:	Thomas Langer/Sheri Michals/ Alphonso A. Collins
Attorney Docket Number:	5367-611PUS-299873.000

Filed as Large Entity

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Submission- Information Disclosure Stmt	1806	1	180	180
		Total in USD ($)		**180**

Electronic Acknowledgement Receipt

EFS ID:	15538820
Application Number:	12995457
International Application Number:	
Confirmation Number:	1889
Title of Invention:	Electronic Device
First Named Inventor/Applicant Name:	Guenter Schmid
Customer Number:	27799
Filer:	Thomas Langer/Sheri Michals/ Alphonso A. Collins
Filer Authorized By:	Thomas Langer
Attorney Docket Number:	5367-611PUS-299873.000
Receipt Date:	17-APR-2013
Filing Date:	18-FEB-2011
Time Stamp:	12:04:49
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$180
RAM confirmation Number	9307
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Information Disclosure Statement (IDS) Form (SB08)	611pus_ids.pdf	63155 2c5750b731229c0581bdbb9a1ef16c0a9d7fa03b	no	3
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
2	Non Patent Literature	12_20_2012_TWOA.pdf	1250682 fd2ab33d36f224fd6fcddd2ee73d5c55a2b33a7b	no	7
Warnings:					
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3	Foreign Reference	TW_200746898.pdf	7685694 cfb3e8a20010b5cd26e4ec936ab2547ca46d2152	no	120
Warnings:					
Information:					
4	Foreign Reference	TW_543342.pdf	6935402 7205bd3366d1bfb0984864a17a70a740acb2e1ba	no	89
Warnings:					
Information:					
5	Fee Worksheet (SB06)	fee-info.pdf	30203 e4c9ce25e5a2ea86e442ce2d0c52bdb385835f84	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	15965136		

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<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of
Guenter SCHMID et al.
Serial No.: 12/995,457
Filed: February 18, 2011
For: Electronic Device

Examiner: HO, Anthony
Group Art: 2815

Confirmation #: 1889

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT

SIR:

PETITION

Applicants hereby petition for a one-month extension of the original shortened statutory response period set in the Office Action of April 4, 2013. Submitted herewith is the amount of **$200** in payment of the government fee for a one-month extension of time so that the period for response is extended to August 4, 2013 (Sunday).

RESPONSE

In response to the Office Action dated April 4, 2013, please amend the above-identified application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 6 of this paper.

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Currently amended) An electronic device, comprising:

a substrate;

a first electrode;

at least one organic functional layer; and

a second electrode, wherein the at least one organic functional layer is located between the first electrode and the second electrode, and wherein the at least one organic functional layer has at least a first matrix material, a second matrix material, and a third matrix material, and the third matrix material has a Lowest Unoccupied Molecular Orbital (LUMO), which is energetically lower than the LUMO of the second matrix material and the LUMO of the first matrix material, and wherein the second matrix material has a Highest Occupied Molecular Orbital (HOMO), which is energetically higher than the HOMO of the first matrix material and the HOMO of the third matrix material,

wherein the organic functional layer is an emission layer and is doped with at least one emitter material.

2. (Previously presented) The electronic device according to claim 1, wherein the first matrix material has a LUMO which is energetically higher than the LUMO of the second matrix material and the LUMO of the third matrix material, and a HOMO which is energetically lower than the HOMO of the second matrix material and the HOMO of the third matrix material.

3. (Previously presented) The electronic device according to claim 1, wherein the second matrix material has a LUMO which is energetically higher than the LUMO of the third matrix material, and a HOMO which is energetically higher than the HOMO of the third matrix material.

4. (Previously presented) The electronic device according to claim 1, wherein the first matrix material has a charge carrier mobility which is lower than the charge carrier mobilities of the second and third matrix materials.

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5. (Previously presented) The electronic device according to claim 1, wherein the second matrix material comprises a hole transport material.

6. (Previously presented) The electronic device according to claim 1 wherein the third matrix material comprises an electron transport material.

7. (Previously presented) The electronic device according to claim 1, wherein the organic functional layer is selected from a group which comprises emission layers, electron transport layers, hole transport layers, electron blocking layers, hole blocking layers, hole injection layers, electron injection layers, and intermediate layers.

Claim 8. (Canceled)

9. (Previously presented) The electronic device according to claim 1, wherein the emitter material in the emission layer has a concentration of $\leq$ 10 wt%.

10. (Previously presented) The electronic device according claim 1, wherein the concentration of the emitter material in the emission layer has a gradient.

11. (Currently amended) The electronic device according to claim [[8]] 1, wherein the LUMO of the emitter material is energetically lower than the LUMO of the first, second, and third matrix materials, and the HOMO of the emitter material is energetically higher than the HOMO of the first, second, and third matrix materials.

12. (Previously presented) The electronic device according to claim 1, which is constructed as a radiation-emitting device.

13. (Previously presented) The electronic device according to claim 1, wherein the device is selected from a group which comprises an organic light-emitting device, a solar cell, and a transistor.

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14. (Previously presented) A method for the production of an electronic device according to claim 1, comprising the steps of:

A) preparation of a substrate;

B) preparation of a first electrode and a second electrode; and

C) placement of at least one organic functional layer between the first electrode and the second electrode,

wherein in method step C), at least the first matrix material, the second matrix material, and the third matrix material are simultaneously applied.

15. (Currently amended) A method according to claim [[1]] 14, wherein in the method step C), the first matrix material, the second matrix material, and the third matrix material are applied by evaporation coating.

16. (New) An electronic device, comprising:

a substrate;

a first electrode;

at least one organic functional layer; and

a second electrode, wherein the at least one organic functional layer is located between the first electrode and the second electrode, and wherein the at least one organic functional layer has at least a first matrix material, a second matrix material, and a third matrix material, and the third matrix material has a Lowest Unoccupied Molecular Orbital (LUMO), which is energetically lower than the LUMO of the second matrix material and the LUMO of the first matrix material, and wherein the second matrix material has a Highest Occupied Molecular Orbital (HOMO), which is energetically higher than the HOMO of the first matrix material and the HOMO of the third matrix material,

wherein the first matrix matrial has a LUMO which is energetically higher than the LUMO of the second matrix material and the LUMO of the third matrix material, and a HOMO which is energetically lower than the HOMO of the second matrix material and the HOMO of the third matrix material.

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17. (New) An electronic device, comprising:

a substrate;

a first electrode;

at least one organic functional layer; and

a second electrode, wherein the at least one organic functional layer is located between the first electrode and the second electrode, and wherein the at least one organic functional layer has at least a first matrix material, a second matrix material, and a third matrix material, and the third matrix material has a Lowest Unoccupied Molecular Orbital (LUMO), which is energetically lower than the LUMO of the second matrix material and the LUMO of the first matrix material, and wherein the second matrix material has a Highest Occupied Molecular Orbital (HOMO), which is energetically higher than the HOMO of the first matrix material and the HOMO of the third matrix material,

wherein the first matrix material has a charge carrier mobility which is lower than the charge carrier mobilities of the second and third matrix materials.

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REMARKS/ARGUMENTS

Claims 2, 4, 5, 8-11, 14 and 15 have been indicated by the Examiner as being allowable if suitably rewritten in independent form.

Allowable claim 8 (now canceled) has been incorporated into claim 1 from which it was directly dependent. Thus, claim 1 is in condition for allowance.

Claims 2-7 and 9-15 are dependent, either directly or indirectly, from claim 1. Thus, these claims are in condition for allowance.

Independent claim 16 has been added. It is a combination of claim 1 and allowable claim 2. Thus, claim 16 is in condition for allowance.

Independent claim 17 has been added. It is a combination of claim 1 and allowable claim 4. Thus, claim 17 is in condition for allowance.

Prompt allowance of this application is respectfully solicited.

It is believed that no fees or charges are required at this time in connection with the present application. However, if any fees or charges are required at this time, they may be charged to our Patent and Trademark Office Deposit Account No. 503111.

Respectfully submitted,
COZEN O'CONNOR

By /Thomas Langer/
Thomas Langer
Reg. No. 27,264
277 Park Avenue
New York, New York 10172
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Dated: August 5, 2013

SDC EX. 1002 - 257/325

Electronic Patent Application Fee Transmittal

Application Number:	12995457
Filing Date:	18-Feb-2011
Title of Invention:	Electronic Device
First Named Inventor/Applicant Name:	Guenter Schmid
Filer:	Carl Brian Wischhusen
Attorney Docket Number:	5367-611PUS-299873.000

Filed as Large Entity

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 1 month with $0 paid	1251	1	200	200

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**200**

Electronic Acknowledgement Receipt

EFS ID:	16506068
Application Number:	12995457
International Application Number:	
Confirmation Number:	1889
Title of Invention:	Electronic Device
First Named Inventor/Applicant Name:	Guenter Schmid
Customer Number:	27799
Filer:	Carl Brian Wischhusen
Filer Authorized By:	
Attorney Docket Number:	5367-611PUS-299873.000
Receipt Date:	05-AUG-2013
Filing Date:	18-FEB-2011
Time Stamp:	19:15:58
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$200
RAM confirmation Number	6380
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1		5367-611PUS-Amendment.pdf	100687 e70c0192745900125a16dafb56a676c44cfd25dd	yes	6

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Amendment/Req. Reconsideration-After Non-Final Reject	1	1
Claims	2	5
Applicant Arguments/Remarks Made in an Amendment	6	6

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30300 c5a9390f75b7b6ad2b7a29ad436683c0eae3b226	no	2

Warnings:

Information:

Total Files Size (in bytes):	130987

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 12/995,457	Filing Date 02/18/2011	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT

08/05/2013	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 16	Minus	** 20	= 0	X $80 =	0
Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 0	X $420 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	0

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/ANGELA s. WHITE/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

27799 7590 08/19/2013

Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172

EXAMINER	
HO, ANTHONY	
ART UNIT	PAPER NUMBER
2815	

DATE MAILED: 08/19/2013

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,457	02/18/2011	Guenter Schmid	5367-611PUS-299873.000	1889

TITLE OF INVENTION: ELECTRONIC DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1780	$300	$0	$2080	11/19/2013

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

27799 7590 08/19/2013
Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,457	02/18/2011	Guenter Schmid	5367-611PUS-299873.000	1889

TITLE OF INVENTION: ELECTRONIC DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1780	$300	$0	$2080	11/19/2013

EXAMINER	ART UNIT	CLASS-SUBCLASS
HO, ANTHONY	2815	257-040000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

SDC EX. 1002 - 264/325

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29	NOTE: Absent a valid certification of Micro Entity Status (see form PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
❑ Applicant asserting small entity status. See 37 CFR 1.27	NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
❑ Applicant changing to regular undiscounted fee status.	NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,457	02/18/2011	Guenter Schmid	5367-611PUS-299873.000	1889

27799 7590 08/19/2013

Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172

EXAMINER	
HO, ANTHONY	

ART UNIT	PAPER NUMBER
2815	

DATE MAILED: 08/19/2013

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 319 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 319 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 12/995,457	Applicant(s) SCHMID ET AL.	
	Examiner ANTHONY HO	Art Unit 2815	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *amendment filed August 5, 2013*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *1-7 and 9-17*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☒ All b) ☐ Some *c) ☐ None of the:
   1. ☒ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 4/17/2013
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

DETAILED ACTION

This is in response to amendment to application no. 12/995,457 filed on April 17, 2013.

Claims 1-7 and 9-17 are presented for examination.

Claim 8 has been cancelled.

Information Disclosure Statement

1. The information disclosure statement (IDS) submitted on April 17, 2013 was filed after the mailing date of the Non-Final Rejection on April 4, 2013. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Allowable Subject Matter

2. Claims 1-7 and 9-17 are allowed.

3. The following is an examiner's statement of reasons for allowance: The prior arts of record do not disclose or suggest at least the limitations of "an electronic device wherein the organic functional layer is an emission layer and is doped with at least one emitter material" as recited in claim 1, "an electronic device wherein the first matrix matrial has a LUMO which is energetically higher than the LUMO of the second matrix material and the LUMO of the third matrix material, and a HOMO which is energetically lower than the HOMO of the second matrix material and the HOMO of the third matrix material" as recited in claim 16, and "an electronic device wherein the first matrix

material has a charge carrier mobility which is lower than the charge carrier mobilities of the second and third matrix materials" as recited in claim 17.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled “Comments on Statement of Reasons for Allowance.”

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANTHONY HO whose telephone number is (571)270-1432. The examiner can normally be reached on Monday to Friday: 1:30PM - 10:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Kenneth Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Anthony Ho/
Primary Examiner, Art Unit 2815

PTO/SB/08A (04-03)
Approved for use through 04/30/2003. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number

Substitute for Form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 1

Complete if Known	
Application Number	12/995,457
Filing Date	February 18, 2011
First Named Inventor	Guenter SCHMID
Art Unit	2815
Examiner Name	HO, Anthony
Attorney Docket	5367-611PUS - 299873.000

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Document Number Number-Kind-Code [2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-			
		US-			
		US-			
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		US-			

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Foreign Patent Document Country Code[3]- Number[4]- Kind-Code [5] (if known	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
		TW 200746898	12-16-2007	Kondakova et al.		Abs.
		TW 543342	07-21-2003	Seo et al.		Abs.

Examiner Signature	/Anthony Ho/	Date Considered	08/08/2013

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, Washington, DC 20231.**

If you need assistance in completing the form, call 1-800-PTO-9199 (1-800-786-9199) and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

BIB DATA SHEET

CONFIRMATION NO. 1889

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/995,457	02/18/2011 RULE	257	2815	5367-611PUS-299873.000

APPLICANTS

Guenter Schmid, Hemhofen, GERMANY;
Ralf Krause, Erlangen, GERMANY;
Stefan Seidel, Nittendorf, GERMANY;
Oliver Weiss, Dossenheim, GERMANY;
Christoph Gaerditz, Regensburg, GERMANY;
Riikka Suhonen, Oulu, FINLAND;
Ulrich Niedermeier, Leiblfing, GERMANY;
Fryderyk Kozlowski, Erlangen, GERMANY;

**** CONTINUING DATA ***************************

This application is a 371 of PCT/DE2009/000701 05/18/2009

**** FOREIGN APPLICATIONS ***************************

GERMANY 10 2008 025 920.9 05/30/2008
GERMANY 10 2008 039 361.4 08/22/2008

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****

08/17/2011

Foreign Priority claimed	35 USC 119(a-d) conditions met	Verified and Acknowledged	Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
☑ Yes ☐ No	☑ Yes ☐ No	/ANTHONY HO/ Examiner's Signature	☑ AH Initials	GERMANY	5	15	2

ADDRESS

Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172
UNITED STATES

TITLE

Electronic Device

FILING FEE RECEIVED		
1110	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995457	SCHMID ET AL.
	Examiner	Art Unit
	ANTHONY HO	2815

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
257	40, e51.001	3/22/2013	AH

SEARCH NOTES		
Search Notes	Date	Examiner
consult related PCT case	3/22/2013	AH
conduct EAST search	3/22/2013	AH
considered IDS filed 4/17/2013	8/8/2013	ah

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
257/40	40, e51.001	8/8/2013	ah

Issue Classification

Application/Control No.	Applicant(s)/Patent Under Reexamination
12995457	SCHMID ET AL.
Examiner	**Art Unit**
ANTHONY HO	2815

CPC						
Symbol					**Type**	**Version**
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CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
			/					
			/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	16	
/ANTHONY HO/ Primary Examiner.Art Unit 2815	08/08/2013	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995457	SCHMID ET AL.
	Examiner	**Art Unit**
	ANTHONY HO	2815

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION										
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED					
257	40	H	0	1	L	35 / 24 (2006.01.01)						

CROSS REFERENCE(S)					
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
257	E51.001				

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	16	
/ANTHONY HO/ Primary Examiner.Art Unit 2815	08/08/2013	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995457	SCHMID ET AL.
	Examiner	**Art Unit**
	ANTHONY HO	2815

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1														
2	2														
3	3														
4	4														
5	5														
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8	9														
9	10														
10	11														
11	12														
12	13														
13	14														
14	15														
15	16														
16	17														

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 16	
/ANTHONY HO/ Primary Examiner.Art Unit 2815 (Primary Examiner)	08/08/2013 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995457	SCHMID ET AL.
	Examiner	Art Unit
	ANTHONY HO	2815

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/22/2013	08/08/2013							
1	1	✓	=							
2	2	O	=							
3	3	✓	=							
4	4	O	=							
5	5	O	=							
6	6	✓	=							
7	7	✓	=							
	8	O	-							
8	9	O	=							
9	10	O	=							
10	11	O	=							
11	12	✓	=							
12	13	✓	=							
13	14	O	=							
14	15	O	=							
15	16		=							
16	17		=							

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	242581	@pd>"20130321"	US-PGPUB; USPAT	OR	OFF	2013/08/08 19:15
L2	8963	257/40.ccls.	US-PGPUB; USPAT	OR	OFF	2013/08/08 19:15
L3	717	1 and L2	US-PGPUB; USPAT	OR	OFF	2013/08/08 19:15
L4	650	257/e51.001.ccls.	US-PGPUB; USPAT	OR	OFF	2013/08/08 19:15
L5	52	1 and L4	US-PGPUB; USPAT	OR	OFF	2013/08/08 19:15

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L6	3807	257/40.ccls.	USPAT; UPAD	OR	OFF	2013/08/08 19:15
L7	336	257/e51.001.ccls.	USPAT; UPAD	OR	OFF	2013/08/08 19:15

8/8/2013 7:27:02 PM
C:\Users\aho1\Documents\EAST\Workspaces\12995457.wsp

SDC EX. 1002 - 279/325

REQUEST FOR CONTINUED EXAMINATION (RCE) TRANSMITTAL Subsection (b) of 35 USC §132, effective on May 29. 2000, provides for continued examination of an utility or plant application filed on or after June 8. 1995. See The American inventors Protection Act of 1999 (AIPA).		
	Serial Number	12/995,457
	Filing Date	February 18, 2011
	First Named Inventor	SCHMID, Guenter
	Group Art Unit	2815
	Examiner Name	HO, ANTHONY
	Attorney Docket	5367-611PUS\299873

This is a Request for Continued Examination (RCE) under 37 C.F.R. § 1.114 of the above-identified application.

Note: 37 C.F.R. § 1.114 is effective on May 29, 2000. If the above-identified application was filed prior to May 29, 2000 applicant may wish to consider filing a continued prosecution application (CPA) under 37 C.F.R. § 1.53(d) (PTO/SB/29) instead of a RCE to be eligible for the patent term adjustment provisions of the AIPA. See Changes to Application Examination and Provisional Application Practice, Interim Rule, 65 Fed. Reg. 14865 (Mar. 20, 2000), 1233 Off. Gaz. Pat. Office 47 (April 11, 2000), which established RCE practice.

1. Submission required under 37 C.F.R. § 1.114

a. [] Previously submitted
   i. [] Consider the amendment(s)/reply under 37 C.F.R. § 1.116 previously filed on . (Any unentered amendment(s) referred to above will be entered).
   ii. [] Consider the arguments in the Appeal Brief or Reply Brief previously filed on
   iii.[] Other

b. [x] Enclosed
   i. [] Amendment/Reply
   ii. [] Affidavit(s)/Declaration(s)
   iii.[x] Information Disclosure Statement (IDS)
   iv.[] Other

2. Miscellaneous

a. [] Suspension of action of the above-identified application is requested under 37 C.F.R. § 1.103(c) for a period of months. (Period of suspension shall not exceed three months; Fee under 37 C.F.R. § 1.17(I) required)

b. [] Other

3. Fees

The RCE fee under 37 C.F.R. 1.17(e) is required by 37 C.F.R. 1.114 when the RCE is filed.

a. [x] The Director is hereby authorized to charge the following fees, or credit any overpayments, to Deposit Account No.: 503111.
   i. [x] RCE fee required under 37 C.F.R.§ 1.17(e), if not already paid by check
   ii. [ ] Extension of time fee (37C.F.R. §§ 1.136 and 1.17), if not already paid by check
   iii.[] Small Entity Status is being claimed for this application.
   vi.[] Other

b. [] Please charge our deposit account No. 503111 in the amount of $

c. [x] Payment by credit card - in the amount of $1,200.00

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED			
Name (Print/Type)	Edward M. Weisz	Registration No. (Attorney/Agent)	37,257
Signature	/Edward M. Weisz/	Date	November 8, 2013

CERTIFICATE OF MAILING OR TRANSMISSION			
I hereby certify that this correspondence is e-filed, addressed to: Commissioner For Patents, Mail Stop RCE, P.O. Box 1450, Alexandria, VA 22313-1450, or facsimile transmitted to the U.S. Patent and Trademark Office on: November 8, 2013			
Name (Print/Type)	Edward M. Weisz		
Signature	/Edward M. Weisz/	Date	November 8, 2013

Attorney Docket # 5367-611PUS\299873 Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of Schmid, Guenter et al. Serial No.: 12/995,457 Filed: February 18, 2011 For: ELECTRONIC DEVICE	Examiner: HO, ANTHONY Group Art: 2815

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT

S I R:

In compliance with the duty of disclosure under 37 C.F.R. § 1.56 and in accordance with the practice under 37 C.F.R. §§ 1.97 and 1.98, the Examiner's attention is directed to the documents listed on the enclosed Form PTO/SB/08a. Copies of the listed non-US documents are also enclosed.

Enclosed is a copy of a Japanese Letters Patent dated March 15, 2013 issued in the corresponding Japanese Patent No. 5222397.

It is respectfully requested that the above information be considered by the Examiner and that the copy of the enclosed Form PTO/SB/08a be returned indicating that such information has been considered.

SDC EX. 1002 - 281/325

In accordance with 37 C.F.R §§1.97(g) and (h), the filing of this Information Disclosure Statement should not be construed as a representation that a search has been made or that information cited is, or is considered to be, material to patentability as defined in §1.56(b), or that any cited document listed or attached is (or constitutes) prior art. Unless otherwise indicated, the date of publication indicated for an item is taken from the face of the item and Applicants reserve the right to prove that the date of publication is in fact different.

If any fees or charges are deemed required at this time in connection with the application, the same may be charged to our Patent and Trademark Office Deposit Account No. 503111.

Respectfully submitted,
COZEN O'CONNOR

By /Edward M. Weisz/
Edward M. Weisz
Reg. No. 37,257
277 Park Avenue
New York, New York 10172
(212) 883-4900

Dated: November 8, 2013

SDC EX. 1002 - 282/325

PTO/SB/08A (04-03)
Approved for use through 04/30/2003. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number

Substitute for Form 1449/PTO	*Complete if Known*	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)	Application Number	12/995,457
	Filing Date	February 18, 2011
	First Named Inventor	Schmid, Guenter
	Art Unit	2815
	Examiner Name	HO, ANTHONY
Sheet 1 of 1	Attorney Docket	5367-611PUS\299873

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Document Number Number-Kind-Code [2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-			
		US-			
		US-			
		US-			
		US-			

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Foreign Patent Document Country Code[3]- Number[4]- Kind-Code [5] (if known	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
	AA	JP 2002-260861	09-13-2002	Young et al.		Abs.
	AB	JP 2002-305085	10-18-2002	Seo et al.		Abs.
	AC	JP 2002-313583	10-25-2002	Seo et al.		Abs.
	AD	JP 2004-526284	08-26-2004	Thompson et al.		Abs.
	AE	JP 2005-108726	04-21-2005	Hamada et al.		Abs.
	AF	JP 2005-108727	04-21-2005	Hamada et al.		Abs.
	AG	JP 2005-514754	05-19-2005	Thompson et al.		Abs.
	AH	JP 2006-128636	05-18-2006	Nariyuki et al.		Abs.
	AI	JP 2006-165525	06-22-2006	Liu et al.		Abs.
	AJ	JP 2006-228936	08-31-2006	Ise		Abs.
	AK	JP 2010-510675	04-02-2010	Chai et al.		Abs.

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant's unique citation designation number (optional). 2 See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. 3 Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). 4 For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. 5 Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. 6 Applicant is to place a check mark here if English language Translation is attached. This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, Washington, DC 20231.

Attorney Docket # 5367-611PUS\299873 Patent

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of Schmid, Guenter et al. Serial No.: 12/995,457 Filed: February 18, 2011 For: ELECTRONIC DEVICE	Group Art: 2815

REQUEST FOR CORRECTION OF FILING RECEIPT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

SIR:

Attached is a copy of the official filing receipt received from the U.S. Patent and Trademark Office in the above-identified application.

There is an error in:

[X] Applicants' name and/or address

[] Title

[] Filing Date

[] Serial Number

[] Priority Data (country, number, date)

[] Other [pls specify]

which should read as follows under **"Applicants"**:

Ruekka Suhonen, Oulu, FINLAND

A copy of the filing receipt is submitted herewith on which the requested change is entered.

It is respectfully requested that a corrected filing receipt be issued.

Respectfully submitted,
COZEN O'CONNOR

By /Edward M. Weisz/
Edward M. Weisz
Reg. No. 37,257
277 Park Avenue
New York, New York 10172
(212) 883-4900

Dated: November 8, 2013

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/995,457	02/18/2011		1110	5367-611PUS	15	2

CONFIRMATION NO. 1889

27799
Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172

FILING RECEIPT

OC000000049389222

Date Mailed: 08/19/2011

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Applicant(s)

Guenter Schmid, Hemhofen, GERMANY;
Ralf Krause, Erlangen, GERMANY;
Stefan Seidel, Nittendorf, GERMANY;
Oliver Weiss, Dossenheim, GERMANY;
Christoph Gaerditz, Regensburg, GERMANY;
Ruekka ~~Riikka~~ Suhonen, Oulu, FINLAND;
Ulrich Niedermeier, Leiblfing, GERMANY;
Fryderyk Kozlowski, Erlangen, GERMANY;

Assignment For Published Patent Application

OSRAM Opto Semiconductors GmbH, Regensburg, GERMANY

Power of Attorney: The patent practitioners associated with Customer Number 27799

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/DE2009/000701 05/18/2009

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)
GERMANY 10 2008 025 920.9 05/30/2008
GERMANY 10 2008 039 361.4 08/22/2008

If Required, Foreign Filing License Granted: 08/17/2011

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/995,457**

Projected Publication Date: 12/01/2011

SDC EX. 1002 - 286/325

Non-Publication Request: No

Early Publication Request: No

Title

Electronic Device

Preliminary Class

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where

the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

Electronic Patent Application Fee Transmittal

Application Number:	12995457
Filing Date:	18-Feb-2011
Title of Invention:	ELECTRONIC DEVICE
First Named Inventor/Applicant Name:	Guenter Schmid
Filer:	Thomas Langer/Sheri Michals/ Edward M. Weisz
Attorney Docket Number:	5367-611PUS-299873.000

Filed as Large Entity

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Request for Continued Examination	1801	1	1200	1200
		Total in USD ($)		**1200**

Electronic Acknowledgement Receipt

EFS ID:	17351125
Application Number:	12995457
International Application Number:	
Confirmation Number:	1889
Title of Invention:	ELECTRONIC DEVICE
First Named Inventor/Applicant Name:	Guenter Schmid
Customer Number:	27799
Filer:	Thomas Langer/Sheri Michals/ Edward M. Weisz
Filer Authorized By:	Thomas Langer
Attorney Docket Number:	5367-611PUS-299873.000
Receipt Date:	08-NOV-2013
Filing Date:	18-FEB-2011
Time Stamp:	12:57:57
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$1200
RAM confirmation Number	10887
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

SDC EX. 1002 - 291/325

1	Request for Continued Examination (RCE)	rce.PDF	68272 a0d3a027a78d27ee32e28ff963be43840f3573ce	no	1
Warnings:					
This is not a USPTO supplied RCE SB30 form.					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	ids.PDF	129593 85ac17d8302639bf3c914b6509a8cec644cde510	no	3
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3	Non Patent Literature	Letters_Patent_JP_5222397_B2_pdf.pdf	1895339 78abdf19e7c4be25aa2641bf63387cf71ce5b74d	no	10
Warnings:					
Information:					
4	Foreign Reference	JP_2002_260861_with_Abstract_pdf.pdf	1283326 20d7043138d86373fa4c555a6ea9dedf62ec2a32	no	12
Warnings:					
Information:					
5	Foreign Reference	JP_2002_305085_with_Abstract_pdf.pdf	2993519 a4ed5894cedf206ab494d7ad83e063c7956d92aa	no	24
Warnings:					
Information:					
6	Foreign Reference	JP_2002_313583_with_Abstract_pdf.pdf	4522212 d296d9895d2f690bcbd341533588851 64ab4c98c	no	35
Warnings:					
Information:					
7	Foreign Reference	JP_2004_526284_with_Abstract_pdf.pdf	3343554 86d21126884b65296ac31fb4def4fd86c6c2e8d8	no	66
Warnings:					
Information:					
8	Foreign Reference	JP_2005_108726_with_Abstract_pdf.pdf	1220136 0d5f26ff091b5d4bc024abd5425e7af1da7cbe31	no	20
Warnings:					
Information:					

9	Foreign Reference	JP_2005_108727_with_Abstract_pdf.pdf	1326991 69d5965d1dd0686f72c78f5032a5036ee059278d	no	22
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Information:					
10	Foreign Reference	JP_2005_514754_with_Abstract_pdf.pdf	3780078 f319981049ee453c4d15b49dd57d0f6c659fec57	no	42
Warnings:					
Information:					
11	Foreign Reference	JP_2006_128636_with_Abstract_pdf.pdf	2362813 b23a57f8381c8462bb27a824e9302308bf8e874b	no	31
Warnings:					
Information:					
12	Foreign Reference	JP_2006_165525_with_Abstract_pdf.pdf	1528276 94149772cd0ec6730c2cf2236581df05e1ebdd0a	no	18
Warnings:					
Information:					
13	Foreign Reference	JP_2006_228936_with_Abstract_pdf.pdf	1938447 a20db9f45b3ac1c4cacf2236d9d071e713639f09	no	25
Warnings:					
Information:					
14	Foreign Reference	JP_2010_510675_with_Abstract_pdf.pdf	1362558 8169f46374f99c5794747e21b57af5d88c2b6438	no	22
Warnings:					
Information:					
15	Request for Corrected Filing Receipt	request_corr_fr.PDF	194929 fd024c0c5cf9188d4610424c3274916692bbd55f	no	5
Warnings:					
Information:					
16	Fee Worksheet (SB06)	fee-info.pdf	30653 0ec3aaa789237d959e6d2210ed0f596b53a32fc7	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	27980696	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

27799 7590 02/20/2014

Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172

EXAMINER	
HO, ANTHONY	
ART UNIT	PAPER NUMBER
2815	

DATE MAILED: 02/20/2014

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,457	02/18/2011	Guenter Schmid	5367-611PUS-299873.000	1889

TITLE OF INVENTION: ELECTRONIC DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	05/20/2014

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

27799 7590 02/20/2014
Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,457	02/18/2011	Guenter Schmid	5367-611PUS-299873.000	1889

TITLE OF INVENTION: ELECTRONIC DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	05/20/2014

EXAMINER	ART UNIT	CLASS-SUBCLASS
HO, ANTHONY	2815	257-040000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ❑ Applicant certifying micro entity status. See 37 CFR 1.29
  NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27
  NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ❑ Applicant changing to regular undiscounted fee status.
  NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

SDC EX. 1002 - 296/325

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,457	02/18/2011	Guenter Schmid	5367-611PUS-299873.000	1889

27799 7590 02/20/2014

Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172

EXAMINER	
HO, ANTHONY	

ART UNIT	PAPER NUMBER
2815	

DATE MAILED: 02/20/2014

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)

(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 319 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 319 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 12/995,457	Applicant(s) SCHMID ET AL.	
	Examiner ANTHONY HO	Art Unit 2815	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *RCE filed November 8, 2013*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *1-7 and 9-17*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☒ All b) ☐ Some *c) ☐ None of the:
   1. ☒ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 4/17/2013, 11/8/2013
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☒ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Continued Examination Under 37 CFR 1.114

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex Parte Quayle*, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on November 8, 2013 has been entered.

Information Disclosure Statement

3. The information disclosure statement (IDS) submitted on April 17, 2013 was filed after the mailing date of the Notice of Allowance on August 19, 2013. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

4. The information disclosure statement (IDS) submitted on November 8, 2013 was filed after the mailing date of the Notice of Allowance on August 19, 2013. The

submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Allowable Subject Matter

5. Claims 1-7 and 9-17 are allowed.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANTHONY HO whose telephone number is (571)270-1432. The examiner can normally be reached on Monday to Friday: 1:30PM - 10:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on 571-272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Anthony Ho/
Primary Examiner, Art Unit 2815

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995457	SCHMID ET AL.
	Examiner	**Art Unit**
	ANTHONY HO	2815

CPC						
Symbol					**Type**	**Version**
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CPC Combination Sets						
Symbol					**Type**	**Set**	**Ranking**	**Version**
			/					
			/					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	16	
/ANTHONY HO/ Primary Examiner.Art Unit 2815	11/11/2013	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995457	SCHMID ET AL.
	Examiner	**Art Unit**
	ANTHONY HO	2815

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION	
CLASS	SUBCLASS	CLAIMED	NON-CLAIMED
257	40	H 0 1 L 35 / 24 (2006.0)	

CROSS REFERENCE(S)					
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
257	E51.001				

NONE	Total Claims Allowed:
(Assistant Examiner) (Date)	16
/ANTHONY HO/ Primary Examiner.Art Unit 2815 11/11/2013	O.G. Print Claim(s): 1 — O.G. Print Figure: 1
(Primary Examiner) (Date)	

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995457	SCHMID ET AL.
	Examiner	**Art Unit**
	ANTHONY HO	2815

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1														
2	2														
3	3														
4	4														
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13	14														
14	15														
15	16														
16	17														

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 16	
/ANTHONY HO/ Primary Examiner.Art Unit 2815 (Primary Examiner)	11/11/2013 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995457	SCHMID ET AL.
	Examiner	Art Unit
	ANTHONY HO	2815

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
257	40, e51.001	3/22/2013	AH

SEARCH NOTES		
Search Notes	Date	Examiner
consult related PCT case	3/22/2013	AH
conduct EAST search	3/22/2013	AH
considered IDS filed 4/17/2013	8/8/2013	ah
considered IDS filed 11/8/2013	11/11/2013	ah

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
257/40	40, e51.001	8/8/2013	ah

PTO/SB/08a (01-03)
Approved for use through 04/30/2003. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Substitute for Form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 1

Complete if Known	
Application Number	12/995,457
Filing Date	February 18, 2011
First Named Inventor	Guenter SCHMID
Art Unit	2815
Examiner Name	HO, Anthony
Attorney Docket	5367-611PUS - 299873.000

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Document Number Number-Kind-Code [2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-			
		US-			
		US-			
		US-			
		US-			
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		US-			
		US-			
		US-			

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Foreign Patent Document Country Code[3]- Number[4]- Kind-Code [5] (if known	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
		TW 200746898	12-16-2007	Kondakova et al.		Abs.
		TW 543342	07-21-2003	Seo et al.		Abs.

Examiner Signature	/Anthony Ho/	Date Considered	02/14/2014

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, Washington, DC 20231.
If you need assistance in completing the form, call 1-800-PTO-9199 (1-800-786-9199) and select option 2.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.H./

PTO/SB/08A (04-03)
Approved for use through 04/30/2003. OMB 0651-0031
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Substitute for Form 1449/PTO	*Complete if Known*	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)	Application Number	12/995,457
	Filing Date	February 18, 2011
	First Named Inventor	Schmid, Guenter
	Art Unit	2815
	Examiner Name	HO, ANTHONY
Sheet 1 of 1	Attorney Docket	5367-611PUS\299873

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Document Number Number-Kind-Code [2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US-			
		US-			
		US-			
		US-			
		US-			

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No. [1]	Foreign Patent Document Country Code[3]- Number[4]- Kind-Code [5] (if known	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
	AA	JP 2002-260861	09-13-2002	Young et al.		Abs.
	AB	JP 2002-305085	10-18-2002	Seo et al.		Abs.
	AC	JP 2002-313583	10-25-2002	Seo et al.		Abs.
	AD	JP 2004-526284	08-26-2004	Thompson et al.		Abs.
	AE	JP 2005-108726	04-21-2005	Hamada et al.		Abs.
	AF	JP 2005-108727	04-21-2005	Hamada et al.		Abs.
	AG	JP 2005-514754	05-19-2005	Thompson et al.		Abs.
	AH	JP 2006-128636	05-18-2006	Nariyuki et al.		Abs.
	AI	JP 2006-165525	06-22-2006	Liu et al.		Abs.
	AJ	JP 2006-228936	08-31-2006	Ise		Abs.
	AK	JP 2010-510675	04-02-2010	Chai et al.		Abs.

Examiner Signature	/Anthony Ho/	Date Considered	11/11/2013

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant's unique citation designation number (optional). 2 See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. 3 Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). 4 For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. 5 Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. 6 Applicant is to place a check mark here if English language Translation is attached. This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, Washington, DC 20231.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.H./

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

BIB DATA SHEET

CONFIRMATION NO. 1889

SERIAL NUMBER	FILING or 371(c) DATE RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/995,457	02/18/2011	257	2815	5367-611PUS-299873.000

APPLICANTS

INVENTORS

Guenter Schmid, Hemhofen, GERMANY;
Ralf Krause, Erlangen, GERMANY;
Stefan Seidel, Nittendorf, GERMANY;
Oliver Weiss, Dossenheim, GERMANY;
Christoph Gaerditz, Regensburg, GERMANY;
Ruekka Suhonen, Oulu, FINLAND;
Ulrich Niedermeier, Leiblfing, GERMANY;
Fryderyk Kozlowski, Erlangen, GERMANY;

**** CONTINUING DATA ***************************

This application is a 371 of PCT/DE2009/000701 05/18/2009

**** FOREIGN APPLICATIONS ***************************

GERMANY 10 2008 025 920.9 05/30/2008
GERMANY 10 2008 039 361.4 08/22/2008

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****

08/17/2011

Foreign Priority claimed ☑ Yes ☐ No 35 USC 119(a-d) conditions met ☑ Yes ☐ No Verified and Acknowledged /ANTHONY HO/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		GERMANY	5	15	2

ADDRESS

Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172
UNITED STATES

TITLE

ELECTRONIC DEVICE

FILING FEE RECEIVED		
1110	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12995457	SCHMID ET AL.
	Examiner	**Art Unit**
	ANTHONY HO	2815

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/22/2013	08/08/2013							
1	1	✓	=							
2	2	O	=							
3	3	✓	=							
4	4	O	=							
5	5	O	=							
6	6	✓	=							
7	7	✓	=							
	8	O	-							
8	9	O	=							
9	10	O	=							
10	11	O	=							
11	12	✓	=							
12	13	✓	=							
13	14	O	=							
14	15	O	=							
15	16		=							
16	17		=							

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

27799 7590 02/20/2014
Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,457	02/18/2011	Guenter Schmid	5367-611PUS-299873.000	1889

TITLE OF INVENTION: ELECTRONIC DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	05/20/2014

EXAMINER	ART UNIT	CLASS-SUBCLASS
HO, ANTHONY	2815	257-040000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 Cozen O'Connor
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: **OSRAM Opto Semiconductors GmbH**

(B) RESIDENCE: (CITY and STATE OR COUNTRY): **Regensburg, Germany**

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
☒ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
☐ A check is enclosed.
☒ Payment by credit card. Form PTO-2038 is attached.
☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number 503111 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
☐ Applicant certifying micro entity status. See 37 CFR 1.29
NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
☐ Applicant asserting small entity status. See 37 CFR 1.27
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
☐ Applicant changing to regular undiscounted fee status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature Thomas Langer Date 04/09/2014
Typed or printed name Thomas Langer Registration No. 27,264

SDC EX. 1002 - 311/325

Electronic Patent Application Fee Transmittal

Application Number:	12995457
Filing Date:	18-Feb-2011
Title of Invention:	ELECTRONIC DEVICE
First Named Inventor/Applicant Name:	Guenter Schmid
Filer:	Edward M. Weisz/Dawn Parker
Attorney Docket Number:	5367-611PUS-299873.000

Filed as Large Entity

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl Issue Fee	1501	1	960	960
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**960**

Electronic Acknowledgement Receipt

EFS ID:	18730386
Application Number:	12995457
International Application Number:	
Confirmation Number:	1889
Title of Invention:	ELECTRONIC DEVICE
First Named Inventor/Applicant Name:	Guenter Schmid
Customer Number:	27799
Filer:	Edward M. Weisz/Dawn Parker
Filer Authorized By:	Edward M. Weisz
Attorney Docket Number:	5367-611PUS-299873.000
Receipt Date:	10-APR-2014
Filing Date:	18-FEB-2011
Time Stamp:	16:03:45
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$960
RAM confirmation Number	2676
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Issue Fee Payment (PTO-85B)	5367-611if.PDF	90821 88e47516245fdce51bda4eea7ffac2b4de50b07c	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30732 bff687f981a31cdbd2903c2646bdb1855a32c4f2	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	121553	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
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www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/995,457	05/13/2014	8723164	5367-611PUS-299873.000	1889

27799 7590 04/23/2014

Cozen O'Connor
277 Park Avenue, 20th floor
NEW YORK, NY 10172

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 319 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Guenter Schmid, Hemhofen, GERMANY;
Ralf Krause, Erlangen, GERMANY;
Stefan Seidel, Nittendorf, GERMANY;
Oliver Weiss, Dossenheim, GERMANY;
Christoph Gaerditz, Regensburg, GERMANY;
Ruekka Suhonen, Oulu, FINLAND;
Ulrich Niedermeier, Leiblfing, GERMANY;
Fryderyk Kozlowski, Erlangen, GERMANY;

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Doc Code: PA.
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 01/31/2018. OMB 0651-0035
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

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175540

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Address					
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Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

PICTIVA DISPLAYS INTERNATIONAL LIMITED

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	[signature]	Date (Optional)	[illegible]
Name	Angel Quirion		
Title	Director		

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☐ Total of forms are submitted.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
12/995,457	**06/11/2024 03:05:27 PM Z ET**	**5367-611PUS-299873.000**

Title of Invention

ELECTRONIC DEVICE

Application Information

APPLICATION TYPE	Utility - U.S. National Stage under 35 USC 371	PATENT #	8723164
CONFIRMATION #	1889	FILED BY	Gaby Hecht
PATENT CENTER #	65920436	FILING DATE	02/18/2011
CUSTOMER #	27799	FIRST NAMED INVENTOR	Guenter Schmid
INTL. APPLICATION #	-	INTL. FILING DATE	-
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Richard Botos

Documents

TOTAL DOCUMENTS: 4

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
8723164_statement_373c.pdf	3	Assignee showing of ownership per 37 CFR 3.73	112 KB
8723164 POA Transmittal.pdf	1	Power of Attorney	153 KB
8723164 Change of Correspondence Address Patent.pdf	2	Change of Address	265 KB
POA Pictiva post AIA.pdf	1	Power of Attorney	491 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
8723164_statement_373c.pdf	BF5AE4A197007770B1798C4B9E02E98AE4997176156927D737 93044D6F0DA4E21FBE4F03C2463F9CA96F8DE93843C60DBB2 6B0B87DBA57F4796E296D7FFC80D4
8723164 POA Transmittal.pdf	3B37D4EB7A59E35C7F8F9B67975144399047BA4D4250021DD8 A423C9A328EFE60BA182C4FDC7CF74E6C40E18AF0B891A11 FC769C5A7006D712A45C02FBF20CB0
8723164 Change of Correspondence Address Patent.pdf	A9545E83B7289458C5488882A6018D62AD6EA616D27BFF27AE 9D5C0D47F1AB969C926A44A19669B5695BF47123AEAAFD591 F6CB8818007724AAD4004D228F7E2
POA Pictiva post AIA.pdf	243C3A81AD4CF763772F6163D71A991B098FDBED6D25C4B16 11EF4FB117C972DD1B0B360ED48CA6AE9B510BC490460F0D7 E3EF60098548DF2655A21A7501E17F

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If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: PICTIVA DISPLAYS INTERNATIONAL LIMITED

Application No./Patent No.: 12/995,457/8,723,164 Filed/Issue Date: February 18, 2011/May 13, 2014

Titled: ELECTRONIC DEVICE

PICTIVA DISPLAYS INTERNATIONAL LIMITED, a a Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Inventors To: OSRAM OPTO SEMICONDUCTORS GMBH

   The document was recorded in the United States Patent and Trademark Office at
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2. From: OSRAM OPTO SEMICONDUCTORS GMBH To: OSRAM OLED GMBH

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STATEMENT UNDER 37 CFR 3.73(c)

3. From: OSRAM GMBH To: PICTIVA DISPLAYS INTERNATIONAL LIMITED

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6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
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☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☐ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Richard J. Botos/	June 11, 2024
Signature	Date
Richard J. Botos	32,016
Printed or Typed Name	Title or Registration Number

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The **Privacy Act of 1974 (P.L. 93-579)** requiresthat you begiven certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirementsof the Act, please be advised that: (1)the general authority for the collectionof this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary;and (3) the principalpurpose for whichthe informationis used by the U.S. Patent and Trademark Office is to process and/or examine your submission related toa patent application or patent. If you do not furnishthe requested information, the U.S. Patent and Trademark Officemay not be able to process and/or examine yoursubmission, which may result in termination of proceedings orabandonment of the application or expiration of the patent.

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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Patent Number	8,723,164
Issue Date	05/13/2014
Application Number	12/995,457
Filing Date	02/18/2011
First Named Inventor	Guenter Schmid
Attorney Docket Number	5367-611PUS-299873.000

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I am the:

☐ Patentee.

☐ If the Patentee was not the applicant for patent (37 CFR 1.42), then a Statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is enclosed or was filed on _____. See 37 CFR 3.71.

☑ Attorney or agent of record. Registration Number 32,016.

☐ Patent practitioner acting in a representative capacity whose correspondence address is the correspondence address of record. Notice has been given to the patentee or owner. Registration Number 32,016.

Signature /Richard J. Botos/

Typed or Printed Name Richard J. Botos

Date June 11, 2024 | Telephone (908) 738-1770

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Document Description: Power of Attorney

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Application Number	12/995,457
Filing Date	February 18, 2011
First Named Inventor	Guenter Schmid
Title	ELECTRONIC DEVICE
Art Unit	2815
Examiner Name	ANTHONY HO
Attorney Docket Number	5367-611PUS-299873.000

SIGNATURE of Applicant or Patent Practitioner

Signature	/Richard J. Botos/	Date (Optional)	June 11, 2024
Name	Richard J. Botos	Registration Number	32,016
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

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