

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG DISPLAY CO., LTD.
Petitioner,

v.

PICTIVA DISPLAYS INTERNATIONAL LTD.,
Patent Owner.

Case No. IPR2024-01094
Patent No. 8,558,223

DECLARATION OF PROFESSOR KIRK S. SCHANZE

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TABLE OF CONTENTS

	<u>Page</u>
I. Introduction.....	1
II. Qualification and Experience	2
III. Skilled Artisan	4
IV. WO 2005/086251 (Werner).....	6
A. Millions of Metal Complexes Disclosed By Werner	6
B. Thousands of Possible Matrix Materials Disclosed By Werner	15
C. No Suggestion of Combining $W_2(hpp)_4$ with BPhen or TAZ.....	20
D. Forming an Electron Conducting Layer using $W_2(hpp)_4$ with BPhen or TAZ	33
E. Co-Evaporation of $W_2(hpp)_4$ with BPhen or TAZ.....	34
F. Coordination of BPhen or TAZ to the Tungsten Metal Center in $W_2(hpp)_4$	36
G. A Person of Ordinary Skill in the Art Would Not Expect BPhen or TAZ to Form Chain-Like or Network-Like Structure with $W_2(hpp)_4$	42
H. Werner Does Not Disclose or Suggest Cross-Linking.....	52
V. The Ma Reference.....	53
A. <i>Synthetic Metals</i> Journal.....	53
B. BPhen versus Bistriazine Compound Used in Samsung Products	54
C. BPhen Coordination to Liq	58
D. Ma in light of Shtein Does Not Disclose or Suggest Using OVPD to Obtain a More Uniform Film of Liq and BPhen.....	62

	<u>Page</u>
E. Ma Does Not Disclose or Suggest Cross-Linking	64

I, Kirk S. Schanze, declare as follows:

I. Introduction

1. I have been retained as an independent expert on behalf of Pictiva Displays International Ltd. (“Patent Owner”) to provide certain technical background for the Werner and Ma references that form the basis for the Grounds of unpatentability in the Petition for IPR2024-01094.

2. For this service, I am compensated for my time at my normal consulting rate. My compensation does not depend on the outcome of any matter or on any of the opinions provided below. I have no financial interest in this matter.

3. My testimony herein is based on my technical background, my years of experience in the field of organic light emitting diodes (“OLED”) and my review of the materials cited herein.

4. I provide my testimony from the perspective of a person of ordinary skill in the art at the time of the invention (further address below). I am familiar with the knowledge and skill level of these people based on my 25 years of experience in the OLED field and frequent interactions with such people. For example, at the time of the invention, I had many interactions with postdocs and researchers who had a comparable level of skills as a person of ordinary skill in the art as defined below, including those in my research group.

II. Qualification and Experience

5. I am currently the Robert A. Welch Distinguished University Chair in the Chemistry Department at the University of Texas, San Antonio. A copy of my CV is attached as Appendix A.

6. I earned my B.S. in Chemistry from Florida State University in 1979 and my Ph.D. in Organic Chemistry from the University of North Carolina, Chapel Hill, in 1983. I was a Postdoctoral Research Associate in the Department of Chemistry at the University of North Carolina, Chapel Hill from 1983-1984. I was then a Miller Postdoctoral Fellow in the Chemistry Department of the University of California, Berkeley from 1984-1986.

7. In 1986, I was appointed an Assistant Professor in the Department of Chemistry of the University of Florida. I became an Associate Professor at the University of Florida in 1992 and was appointed full Professor in 1997. From 1997 to 2016, I held various professorship chairs as outlined in my CV. In 2016, I moved to my current position at the University of Texas, San Antonio, where I serve as the Robert A. Welch Distinguished Professor.

8. Throughout my career, I have earned various honors and awards, including the Globalization Award from American Chemical Society (ACS) in 2018. I was made a Fellow of the ACS in 2011, and won the Florida Award from the Florida Section of ACS in 2009. I have also been awarded many Visiting

Professor and Lecturer appointments at various universities throughout Asia. A full list of my Honors and Awards is provided in my CV.

9. I have also held many professional service positions, such as the Chair of the Editor Search Committee for the ACS in 2014 and 2015 and I was the Chair of the ACS Publications Editors Conference in San Diego in 2016. I was Associate Editor of the American Chemical Society (ACS) Journal Langmuir from 2000 – 2008.

10. From 2008 – 2023, I served as founding Editor in Chief (EIC) of ACS Applied Materials & Interfaces. This is one of the largest technical journals in the field of materials chemistry and materials science. As EIC, I overviewed the review of more than 20,000 papers that were submitted annually for consideration to be published.

11. I currently serve as the Deputy Editor for the journal ACS Central Science. This is a premier journal published by ACS Publications in the broad field of Chemistry and allied fields in biology, physics and materials science.

12. My research primarily focuses on work in the fields of conjugated polymers, photochemistry, emission spectroscopy, and organic electronics, including materials and fabrication of organic light emitting diodes and organic solar cells. I am an expert in light applications, including lasers and light sources, spectral filtering, and optical measurements.

13. I have 25 years of experience in the field of organic light emitting diodes and materials, with more than 50 peer reviewed publications and 6 patents in the field. My laboratory is currently engaged in exploring the phenomenon of luminescence (light emission). For example, in our applied work, we are using the light emission process of molecules and materials to develop novel light emitting devices (such as polymer LEDs, a type of OLED), and novel fluorescent sensors. I have collaborated with other academic or industrial laboratories to fabricate OLED devices, and am currently collaborating with researchers at the North Carolina State University on deep blue electrophosphorescent OLED materials and devices. I therefore have familiarity with both the material aspects and the device structural aspects of OLED devices.

III. Skilled Artisan

14. I understand that Samsung defines a person of ordinary skill in the art at the time of the invention as someone with “a university degree in chemistry and additional expertise or a second university degree in the field of electrical engineering, particularly optoelectronics, or alternatively a university degree in electrical engineering and additional expertise or a second university degree in the field of chemistry.” Pet. at 14.

15. I have reviewed Dr. Rand’s curriculum vitae, and I don’t see him having either a degree in the field of chemistry or additional expertise in the field

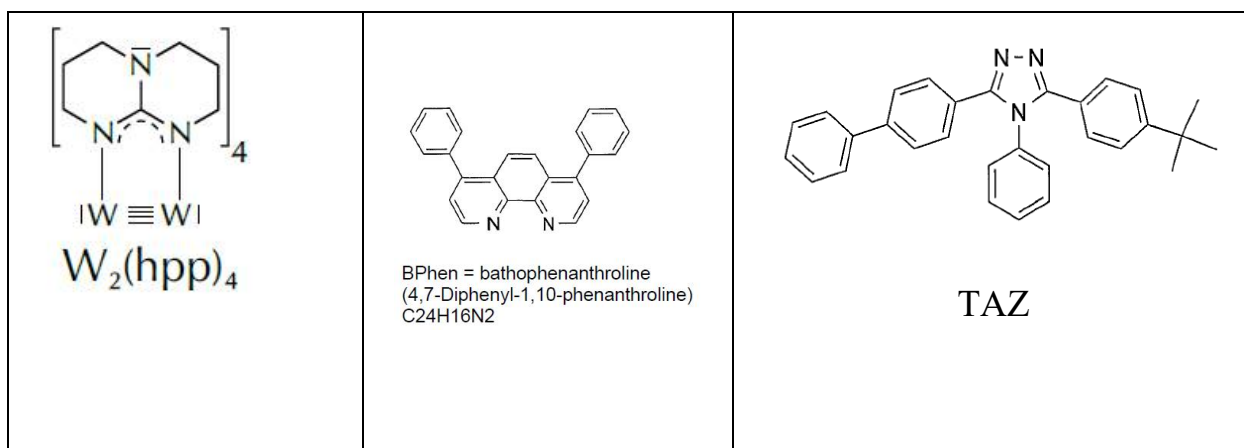
of chemistry, as commonly understood by a chemist. To the extent that his alleged expertise came from his work on OLEDs, then by virtue of my work in OLEDs and solar cells, I would have also had gained expertise in optoelectronics and electrical engineering.

16. This is particularly true in light of the subject matter of the '223 patent. It is my opinion that the subject matter relates mostly to the chemistry and material properties of the electron-conducting layer, with only basic knowledge on the structure of the OLED devices required. I have that device-side knowledge through my years of work in OLEDs. For example, I had “spent several years studying the structure and function of organic optoelectronic components,” including OLEDs, and I have “detailed knowledge of the chemical structure of light-emitting organic layers and the transport of charge carriers to these layers.” Pet. 14. Thus, I qualify as a person “work[ing] at the interface between ... (charge carrier transport and light emission processes in optoelectronic components) and chemistry, in particular organic chemistry (materials and layer stack combinations suitable)” for OLEDs. *Id.*

17. Thus, I was at least a person of ordinary skill in the art, if not one with above average skills, at the time of the invention.

IV. WO 2005/086251 (Werner)

18. I have reviewed the Werner reference. I have been asked to opine on the disclosures of Werner, including whether the litany of metal complexes and matrix materials listed by Werner would have motivated a person of ordinary skill in the art to jointly evaporate tetrakis(1,3,4,6,7,8-hexahydro-2H-pyrimido[1,2-a]pyrimidinato)-ditungsten (II) (“W₂(hpp)₄”) and bathophenanthroline (“BPhen”) or 3-4(-biphenyl)-4-phenyl-5-*tert*-1,2,4-triazole (“TAZ”) as proposed. It is my opinion that it does not.



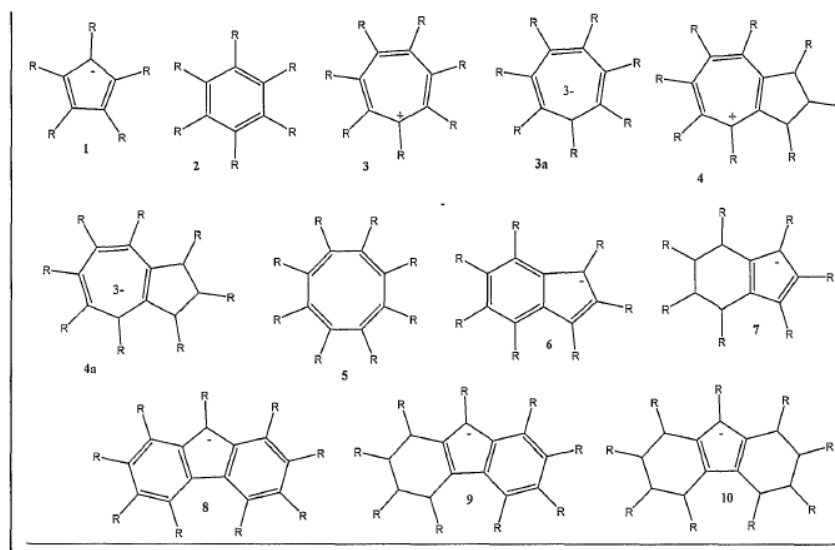
A. Millions of Metal Complexes Disclosed By Werner

19. Werner took a kitchen sink approach when listing the various “advantageous classes of compounds.” See EX1005-10 to EX1005-55. He starts with “Pi-complexes,” which appear to potentially cover any complexes with “a double bond or a triple bond” “wherein the multiple bond can represent, for example, a C-C, C-O, C-N, S-O, N-O bond, without being limited to these.”

EX1005-10. According to Werner, the pi-complex can be an alkene, an alkyne, an allyl complex, a diene complex (such as a butadiene or a cyclobutadiene), a cyclopentadienyl anion, a cycloheptatrienyl cation, a cycloheptatrienyl trianion, a cyclooctadienyl dianion, a carbonyl, a phosphine, aryl (*e.g.*, benzene rings), etc.

Id., EX1005-11. As particularly preferred examples, he listed compounds 1-10 with effectively open-ended substitutions at each carbon atom around the rings.

EX1005-13.



20. For example, Werner states:¹

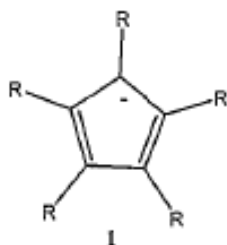
¹ In the paragraph, the “above heteroatoms” and “heteroatoms from the above list” refer to the heteroatoms discussed on EX1005-12/89 (original page number 9) that lists the “following atoms [that] can be used as heteroatoms: B, Al, Ga, In, N, P, As, Sb, Si, Ge, Sn, Pb, O, S, Se, Te.”

The residues R in the base compounds 1-10 can be the same or different, be open-chain or part of a ring or ring system, and are preferably selected from: alkyl, including cycloalkyl, aryl, the above heteroatoms. The alkyl or aryl groups can be fully or partially substituted with one or more, same or different heteroatoms from the above list. It should be understood that the above residues R can also generally be residues according to the invention with a +I effect and/or +M effect on an unsaturated or aromatic ring (or P instead of N). Generally, the residues R in the inventive compounds can also have unsaturated groups, e.g., with C=C, C=N bonds, or the like.

EX1005-13.

21. A person of ordinary skill in the art would recognize that with this broad language, each general structure can result in at least thousands of possible compounds.

22. Take for example the cyclopentadienyl anion shown as Compound 1. This is the ligand used in cobaltocene, the metal complex used in example 3 on EX1005-65.



23. For this compound, even if we limit the residual R to the simplest unsubstituted alkyl (methyl, ethyl, propyl and isopropyl) or phenyl group, that would result in 237 possible combinations:

- 5 combinations of the same R's
- 5×4 for 4 positions with the same R and one different R'
- 60 combinations for 3 positions with the same R's (5 possibilities for the first R, two combinations for arranging the same 3 R's around the ring, and 6 ways of selecting two different R's from the remaining 4 R groups)
- 60 combinations for 2 positions with the same R's and then different R's in the three remaining positions (5 possibilities for the first R, two combinations for arranging the same 2R's around the ring (the two R's are attached to C1 and C2 of the ring or to C1 and C3 of the ring) and 6 ways where the remaining three positions all have different R's)
- 120 combinations for 2 positions with the same R's, 2 positions with the same R's (there are 10 possible pairs of R and R', each pair having four possible arrangements around the ring, with R, R, R' and R' attaching respectively to C1, C2, C3, C4; C1, C2, C3, C5; C1, C3, C2, C4; and C1, C3, C4, C5, and 3 possibilities for the remaining carbon on the ring);
- 12 combinations where each carbon has a different substituent.

24. Adding in the possible substitution with heteroatoms along the methyl, ethyl, propyl or isopropyl chain or phenyl ring, the number of possibilities would increase geometrically. For instance, if each of methyl, ethyl, propyl, isopropyl or phenyl is permitted one substitution with a heteroatom, that would create five more possible “R” groups. In that case, the number of possible combinations for Compound I increases to nearly 6,964:

- 10 combinations of the same R's
- 10×9 for 4 positions with the same R and one different R'
- 720 combinations for 3 positions with the same R's (10 possibilities for the first R, two combinations for arranging the same 3 R's around the ring, and 36 ways of selecting two different R's from the remaining 9 R groups)
- 1680 combinations for 2 positions with the same R's and then different R's in the three remaining positions (10 possibilities for the first R, two combinations for arranging the same 2R's around the ring (the two R's are attached to C1 and C2 of the ring or to C1 and C3 of the ring) and 84 ways where the remaining three positions all have different R's)
- 1,440 combinations for 2 positions with the same R's, 2 positions with the same R's (there are 45 possible pairs of R and R', each pair having four possible arrangements around the ring, with R, R, R' and R' attaching

respectively to C1, C2, C3, C4; C1, C2, C3, C5; C1, C3, C2, C4; and C1, C3, C4, C5, and 8 possibilities for the remaining carbon on the ring);

- 3024 combinations where each carbon has a different substituent ($10 \times 9 \times 8 \times 7 \times 6 / (5 \text{ fold symmetry} \times 2 \text{ head-to-tail})$).

25. Now if we further increase the degree of substitution (*e.g.*, permitting two substitutions per methyl, ethyl, propyl, isopropyl or phenyl group), then that would lead to 15 possible R groups, and the number of possible combinations for Compound I becomes 55,371:

- 15 combinations of the same R's
- 15×14 for 4 positions with the same R and one different R'
- 2730 combinations for 3 positions with the same R's (15 possibilities for the first R, two combinations for arranging the same 3 R's around the ring, and 91 ways of selecting two different R's from the remaining 14 R groups)
- 10,920 combinations for 2 positions with the same R's and then different R's in the three remaining positions (15 possibilities for the first R, two combinations for arranging the same 2R's around the ring (the two R's are attached to C1 and C2 of the ring or to C1 and C3 of the ring) and 364 ways where the remaining three positions all have different R's selecting from 14 possible groups)

- 5,460 combinations for 2 positions with the same R's, 2 positions with the same R's (there are 105 possible pairs of R and R', each pair having four possible arrangements around the ring, with R, R, R' and R' attaching respectively to C1, C2, C3, C4; C1, C2, C3, C5; C1, C3, C2, C4; and C1, C3, C4, C5, and 13 possibilities for the remaining carbon on the ring);
- 36,036 combinations where each carbon has a different substituent ($15 \times 14 \times 13 \times 12 \times 11 / (5 \text{ fold symmetry} \times 2 \text{ head-to-tail})$).

26. There are, however, far more than 15 possible R groups. Werner did not limit the R group to methyl, ethyl, propyl, isopropyl or phenyl-based moieties, and it did not limit the degree of substitutions. Werner also did not limit the type of substitution. And even common substitutions would already include dozens of variations, such as hydroxyl, ether, amino, carbonyls (carboxylates, ketones, aldehydes, amides, ketamines ...), pyridyl, immino, imido, phosphine, phosphide etc. As the degrees of substitution, the type of substitution, and/or the number of carbon atoms in the alkyl or aryl residue increase, there will be more possibilities of R and hence more possible Compound I variations (the number of possible variations would be number of possible R to the fifth power). And this is for Compound I.

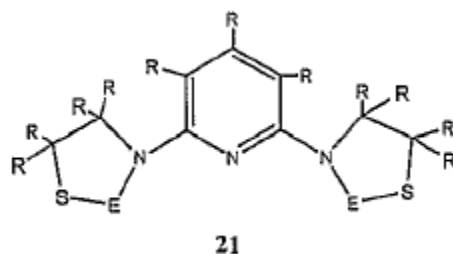
27. Other compounds, such as Compounds 2-10, with even more carbons, would have even more possibilities. For example, for the six-membered

compound 2, 15 possible R's would lead to $15 \times 14 \times 13 \times 12 \times 11 \times 10 / (6 \times 2) = 300,300$ possibilities if all R's are different. These numbers add up quickly.

28. And that is just for ligands. Each ligand can also complex with different metal centers. For instance, Group III metal Sc, Group IV metals, Ti, Zr and Hf, Group V metal (V, Nb and Ta), Group VI metals (Cr, Mo), Group VII metals (*e.g.*, Mn, Re), Group VIII metals (Fe, Ru, Os), Group IX metals (Co, Rh and Ir), Group X metal (Ni) and lanthanide metals such as Y, La all had known complexation with cyclopentadienyl anion or its derivatives, and sometimes in different oxidation states. Hence, there could easily be millions of possible combinations.

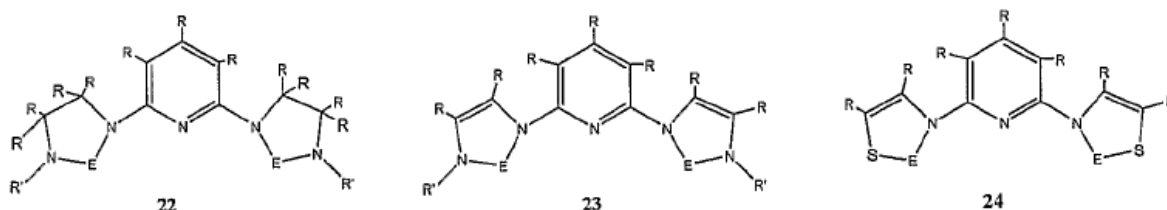
29. Besides pi-complexes, Werner also lists (a) “[p]addlewheel complexes and multinuclear complexes in general,” (b) complexes with ligands “selected from the group of borates, carboranes, triazacycloalkanes, triazacycloalkenes, pyrroles, thiophenes, pyrazoles, imidazole's, thiazoles, oxazoles, pyridines, pyridazines, pyrimidines [and] pyrazines,” (c) complexes with “[t]ripod ligands,” (d) complexes with fullerenes, (e) complexes with pincer ligands such as compounds 19-37, 38-46 and 47-56, (f) complexes with carbene ligands; (g) complexes with silylene ligands; and (h) complexes with germylene ligands, among others. EX1005-10 to EX1005-55. Again, borates, carboranes etc. are each just a generic term that can encompass millions of possible compounds.

30. Even if one is to examine the list on EX1005-63 to 64 in “Application examples,” there are still millions of possible metal complexes. For instance, one preferred example is $\text{Fe}(\text{Ligand})_2$, where the ligand is one of compounds 20 to 37 with E selected from C, Ge or Si, and with R being preferably hydrogen, methyl or ethyl. Werner also says that instead of Fe, the central metal could also be Cr, Mn, Co, Ni, Cu, Zn, Mo or W for a total of nine (9) possible metal centers. For compound 21, when the two E’s are different (*e.g.*, C & Ge, C & Si, or Ge and Si), the compound does not have a symmetry, and the possible combination would be the multiple of (3^{11} , 3 possibilities per R and 11 R’s), the three variations where E’s are different, and 9 possible metal centers = $3^{11} \times 3 \times 9 = 4,782,969$.



31. If we are to limit ligand 21 to R being H or methyl and E being both C or both Ge, that would still result in $2^{11} \times 9 = 18,432$ possibilities. And applying similar analysis to ligands 22-24 and limiting them to R being H or methyl and E being C and Ge result in 73,729 ($2^{13} \times 9$) for compound 22, 4608 ($2^9 \times 9$) possibilities

for compound 23, and 1152 ($2^7 \times 9$) possibilities for compound 24.



32. That is, for just $M(L_2)$ and the most preferred variations, one would still get about 100,000 variations. And Werner does not explain the advantages or disadvantages of these hundreds of thousands possibilities over other short-listed possibilities, including over $W_2(hpp)_4$.

33. Thus, it is my opinion that given Werner's disclosures, a POSITA would not have picked $W_2(hpp)_4$ from the hundreds of thousands or even millions of possibilities in even the most preferred examples on pages 60-61 of the reference (EX1005-63 to EX1005-64).

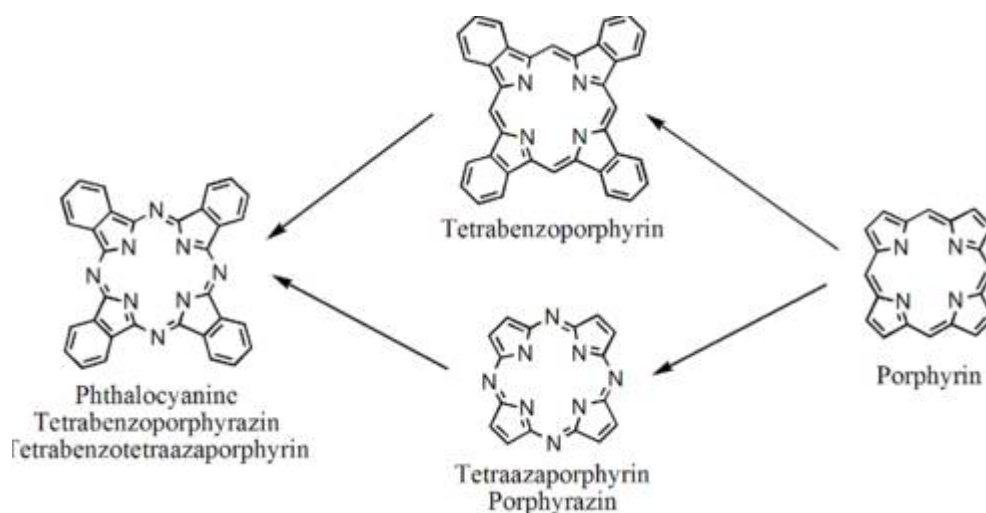
B. Thousands of Possible Matrix Materials Disclosed By Werner

34. Werner also lists a large number of possible matrix materials. Werner states:

The matrix material can consist partially (> 10 or > 25 wt%) or 5 essentially (> 50 wt% or > 75 wt%) or entirely of a metal phthalocyanine complex, a Buckminster fullerene, possibly also a porphyrin complex, in particular a metal porphyrin complex, an oligothiophene, oligophenyl, oligophenylene vinylene, or oligofluorene compound, with the oligomers preferably comprising 2-

500 or more, preferably 2-100 or 2-50 or 2-10 monomeric units. The oligomer can also comprise > 4 , > 6 , or > 10 or more monomeric units, in particular for the ranges indicated above, such as 4 or 6-10 monomeric units, 6 or 10-100 monomeric units, or 10-500 monomeric units. The monomers or oligomers can be substituted or unsubstituted, and block or mixed polymers of the mentioned oligomers can also be present. The matrix can also be a mixture of oligomers with different chain lengths, as is typical for conventional polymer layers.

EX1005-56.

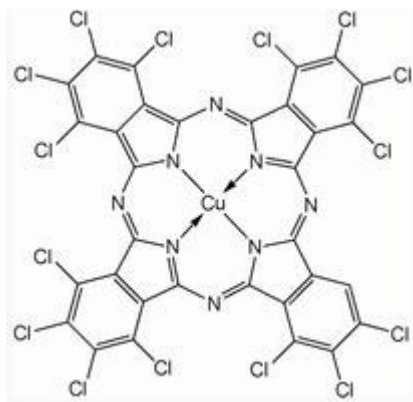


([https://en.wikipedia.org/wiki/Phthalocyanine#:~:text=Phthalocyanine%20\(H%20Pc\)%20is,Phthalocyanine](https://en.wikipedia.org/wiki/Phthalocyanine#:~:text=Phthalocyanine%20(H%20Pc)%20is,Phthalocyanine)).

35. Metal phthalocyanine, fullerene, metal porphyrin, oligothiophene, oligophenyl, oligophenylene-vinylene, or oligofluorene are all classes of materials, and can include not only different substitutions around the phthalocyanine rings, porphyrin rings, fullerenes, but also, different coordination environment for the

metal compounds. For example, Werner states that metal phthalocyanine complexes or porphyrin complexes can be “in the form of oxo ($\text{Me}=\text{O}$), dioxo ($\text{O}=\text{Me}=\text{O}$), imino, diimino, hydroxo, dihydroxo, amino, or diamino complexes, without being limited to these.” EX1005-56:29-34. And “the phthalocyanine or porphyrine complex can be partially hydrogenated” without disturbing the mesomeric ring system. *Id.*, 56:34-36.

36. Phthalocyanines and porphyrins can have different substitutions. For example, the outer aryl rings of the phthalocyanine complex can be substituted with different amounts of halides (see below for an example of hexadecachlorophthalocyaninatocopper ($\text{Cl}_{16}\text{-CuPc}$)).



37. Fluoride substituted phthalocyaninato complexes were also known, for example, hexadecafluorophthalocyaninatozinc ($\text{F}_{16}\text{-ZnPc}$) n-doped with TTN was known. *See* EX2003-2016ChemReview, 13720 (citing Reference No. 114 published in 2005). Substitution with these electron withdrawing groups tends to lower the LUMO level of the resulting metal complexes, making them easier to be

n-doped. *Id.*, 13720 (noting that ZnPc without substitution “has a substantially higher LUMO than F16-ZnPc, making it even more difficult to dope”).

38. Additionally, substitution with electron withdrawing carbonyls, imino, phenyl type of ligands could also lead to more pi-electron distribution, a property that Werner apparently finds desirable. EX1005-56:34-36 (emphasizing the preference for not disturbing the mesomeric ring scheme, which distributes pi-electrons over the ring system). Hence, given the number of possible positions for substitution and the known type of electron withdrawing groups, the possible number of metal phthalocyanines is large. For instance, if we just look to substituting the phthalocyanine ring with Cl or F, for each peripheral ring that would lead to 4 possibilities for 1 halide per peripheral ring, 8 possibilities for 2 halides per peripheral ring + 16 possibilities for 3 halides per peripheral ring and 10 possibilities for 4 halides, for a total of 38 possibilities per ring. There are four peripheral rings, yielding 73815 combinations if all rings are different and each combination can have 6 different arrangements around the metal center (e.g., clockwise, ABCD, ABDC, ACBD, ACDB, ADBC, ADCB), resulting in a total of 442,890 possibilities. This number does not include combinations where two or more of the ring are the same.

39. Furthermore, Werner states that the preferred metals for phthalocyanine is Mg, Zn, Fe, Ni, Co, Cu, Mn or V. EX1005-56:36-57:2. This,

coupled with the number of possible phthalocyanines, yields over 3.5 million possible combinations.

40. In addition to the above, Werner also states that matrix materials can be “a compound with triarylamine or a spirobifluorene compound,” materials with “electron-donating substituents such as alkyl or alkoxy groups,” “[q]uinolinato complexes,” “[p]henanthrolines” and “[h]eteroaromatics, in particular, triazole.” EX1005-56 to-58. Those can easily yield another millions of possibilities.

41. Furthermore, while Werner mentions that BPhen or TAZ “can be used as a matrix material,” Werner also notes that the matrix material “preferably consists entirely of a metal phthalocyanine complex, in particular ZnPc, a porphyrin complex, or a Buckminster fullerene, in particular fullerene C₆₀.” EX1005-58. A person of ordinary skill in the art would view this statement as suggesting that BPhen and TAZ could be used, but the preferred ones would be metal phthalocyanine or porphyrin complex or a fullerene, in particular ZnPc or C₆₀.

42. This suggestion becomes even clearer when the examples are reviewed, which involved only ZnPc and C₆₀. *See* EX1005-64 to -65 (Examples 1-3). Werner did not demonstrate n-doping for BPhen or TAZ using any of his enumerated donor compounds.

C. No Suggestion of Combining $W_2(hpp)_4$ with BPhen or TAZ

43. Given the number of possible metal donor complexes and matrix materials, unless Werner or another reference gives specific suggestion of combining $W_2(hpp)_4$ with BPhen or TAZ, a person of ordinary skill in the art would not have examined the combination in particular.

44. Notably, although Werner mentions the synthesis of a ditungsten compound with a substituted hpp ligand, (see EX1005-47, Example 5), Werner does not use it in its “Application examples.” This would suggest to a person of ordinary skill in the art that the ditungsten complex is not an effective donor.

45. Additionally, before the inventors reported their reaction of $W_2(hpp)_4$ with organic compounds having heteroaromatic moieties in the patent, the only reported reactions between $W_2(hpp)_4$ and organic compounds that I was able to locate are those in solutions with methylene chloride, fullerene C_{60} , and TCQN. See EX2008-Cotton_Inorganic_Chem_Comm] & EX2009-Cotton_Science (reporting solution-based reactions). There is no teaching in the prior art of reacting $W_2(hpp)_4$ with phenanthrolines or triazoles in general and BPhen and TAZ in particular.

46. This is likely for a good reason: the LUMOs of BPhen and TAZ are much higher than those of ZnPc and C_{60} , such that donation of electrons from

$W_2(hpp)_4$ to BPhen and TAZ are more difficult than for ZnPc and C_{60} , as illustrated below:²

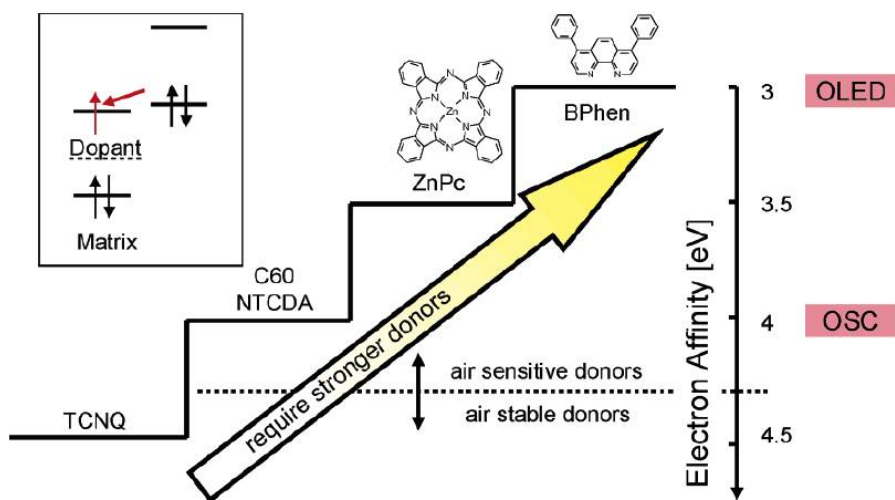


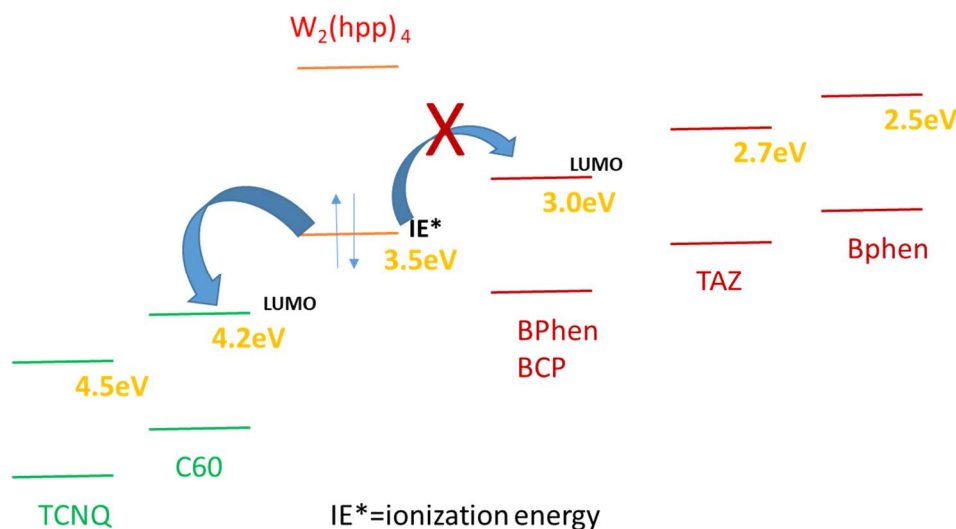
Figure 14. n-Type doping of molecular materials relevant for OLED and organic solar cells requires different electron affinities. While organic solar cells may be doped with donors having a HOMO around 4.0 eV, OLEDs require stronger donors with a HOMO at about 3.0 eV. Such materials are increasingly unstable in air, which requires handling under protective atmosphere only. The “staircase” shows typical host materials for OLEDs and OSCs.

(EX2002_2007WaltzChemReivew, 1244, Fig. 14)s

47. As the authors of the 2007 Chemical Review article noted, for OLED materials with a LUMO of around 3.0eV (or an electron affinity around 3.0eV), the HOMO level of the electron donor should be about 3.0eV. The HOMO level is the energy level of the highest occupied molecular orbital, and according to Koopman’s theorem, the first ionization energy of a molecule is equal to the negative of the energy of the HOMO of the molecule. So for $W_2(hpp)_4$, because it

² The values for the energy levels discussed here are absolute values, and the energy levels are negative.

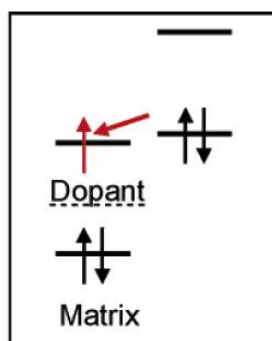
was reported to have an onset of ionization at about 3.51eV (*see* EX2004-Cotton-textbook, 189), its HOMO would be considered to have an energy level about 3.51eV. That means, the electron transfer from $W_2(hpp)_4$ to BPhen (and TAZ) would be endothermic and unfavorable. In contrast, the electron transfer from $W_2(hpp)_4$ to C_{60} and TCNQ (two compounds that $W_2(hpp)_4$ was able to reduce) would be favorable.



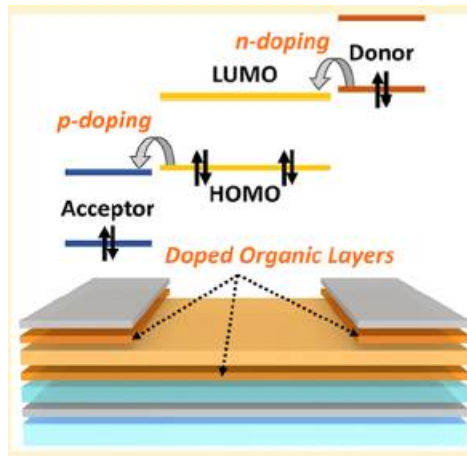
48. This is consistent with the understanding of the n-doping mechanism by low ionization potential molecules in the 2008-2009 time frame.³ For instance, a person of ordinary skill in the art would understand that n-doping by $W_2(hpp)_4$ occurs by removing an electron from the donor (the energy for which is

³ And Werner's objective is to dope matrix materials with n-dopant. *See* EX1005-59.

ionization energy) and injecting it into the LUMO of the matrix material, as illustrated below:



(EX2002-2007-Chem-Review, 1244, Fig. 14 (noting “n-Type doping of molecular materials relevant for OLED and organic solar cells requires different electron affinities”⁴ and “OLEDs require stronger donors with a HOMO at about 3.0eV.)



⁴ Under the Hartree-Fock model, the LUMO orbital energy is a Koopman's approximation to minus the electron affinity (EA). *See* EX2013, introduction. For small molecules, the estimates are often inaccurate in terms of absolute values. *Id.*

(EX2003-Chem-Review, Abstract)

49. A person of ordinary skill in the art would therefore expect that electron donation from a donor to an acceptor would occur when the HOMO or ionization energy of the donor is higher than the LUMO energy level of the acceptor, such as when $W_2(hpp)_4$ is paired with C_{60} or TCQN. Alternatively, if the LUMO energy level of the electron acceptor is the same as or higher than the ionization energy of the donor, the difference in the energy levels should be relatively small, such as about 0.1eV to make the electron injection not too energetically unfavorable. An energy difference of 0.5eV and more as in the case of BPhen/TAZ and $W_2(hpp)_4$ would be viewed as too energetically unfavorable for electron transfer from $W_2(hpp)_4$ to BPhen/TAZ occur.

50. Put another way, the 0.5-1 eV difference in the LUMO level of BPhen and the ionization level of $W_2(hpp)_4$ and the 0.8eV difference in the LUMO level of TAZ and the ionization energy of $W_2(hpp)_4$ would discourage rather than motivate a person of ordinary skill in the art to combine $W_2(hpp)_4$ with BPhen or TAZ to obtain an n-doped layer as Samsung suggests. That is, a person of ordinary skill in the art would not consider the electron transfer in such pairs likely and would not consider $W_2(hpp)_4$ to be a suitable n-dopant for BPhen or TAZ

51. I now provide references that indicate the LUMO levels of BPhen, TAZ, C_{60} and TCNQ.

52. The reported LUMO levels for BPhen differed quite significantly. Some used 2.5eV as BPhen's LUMO level and others used 3.0eV. For example, Li and co-authors used 2.5eV as the LUMO level for BPhen. EX2005, Figure 4):

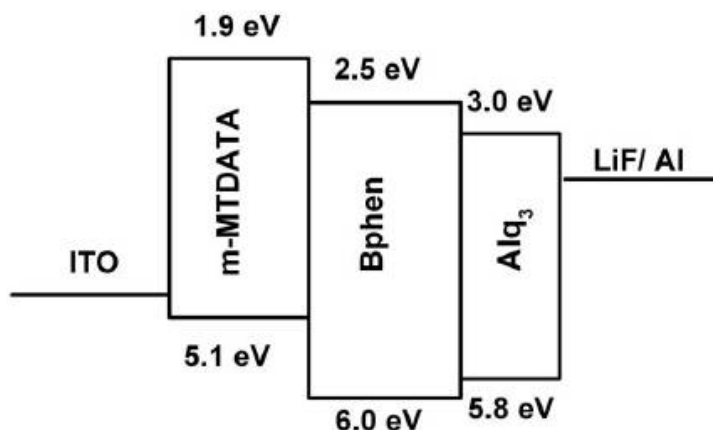


FIG. 4. Schematic LUMO and HOMO energy level diagram of three-layer OLED device.

53. Mr. Li obtained the 2.5eV value from a paper by Xin. EX2006, Fig. 7:

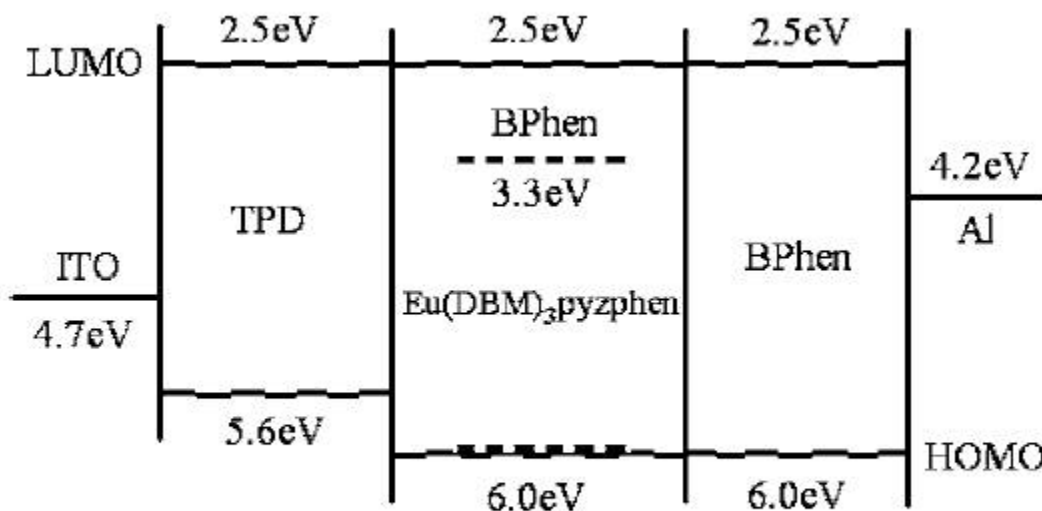


FIG. 7. Energy level diagram of the device used in this paper.

54. In contrast, Ma considered BPhen to have a LUMO of about 3.0eV. EX1017, 813. Ma referenced a Naka paper for this value. I have reviewed the referenced paper, but could not find a value for the HOMO/LUMO levels of BPhen. EX2014. I also note that the 2007 Chemical Review paper by Walzer et al. regarded BPhen as having an electron affinity of about 3.0eV, though it is not clear what was the source of that value. EX2002-2007-Chem-Review, Fig. 14. This variation in the exact LUMO level, however, does not change my conclusion because even a 0.5eV difference in the LUMO level of BPhen and the ionization energy of $W_2(hpp)_4$ would be considered too large and energetically unfavorable, consistent with Walzer's observation that donors of HOMO levels of 3.0eV (and higher) are needed to n-dope materials such as BPhen suitable for OLED applications.

55. TAZ's LUMO was reported to be about 2.7eV. EX2007, Fig. 3.

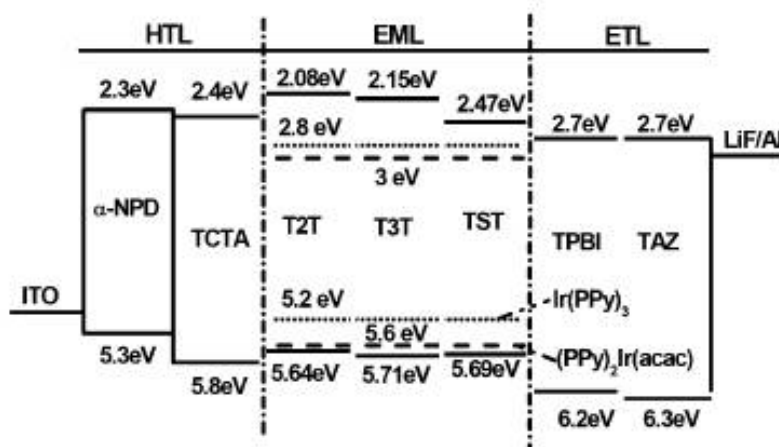


Fig. 3 Energy levels of the HTLs, EMLs, and ETLs used in this study.

56. There is thus again a large gap in the LUMO energy level of TAZ and the ionization energy of $W_2(hpp)_4$. In light of the energy gap, a person of ordinary skill in the art would not have used $W_2(hpp)_4$ as a n-dopant for TAZ or expected that n-doping would be successful.

57. The estimated LUMO level of C_{60} was reported to be about 4.2 eV. See EX2011, Fig. 3 (see below). This value is consistent with that shown in Figure 14 of the 2007 Chemical Review Article by Walzer et al. EX2002-2007ChemReivew, Fig. 14.

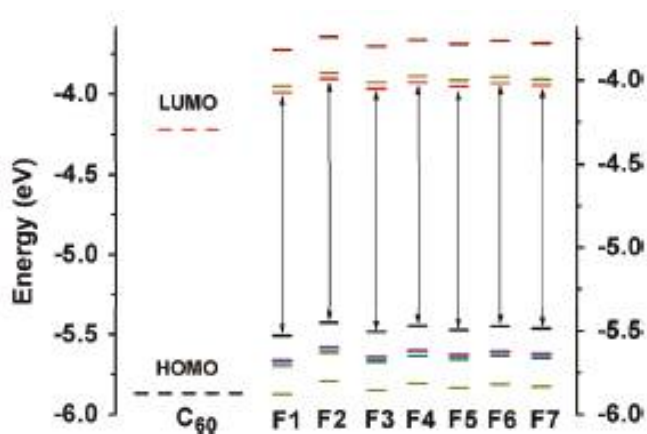


Figure 3. Energy levels of C_{60} and its derivatives calculated at the PBEPBE/6-311G(d,p) level. C_{60} has 5-fold degenerated HOMOs and 3-fold degenerated LUMOs, while the related energy levels for fullerene derivatives become nondegenerated. The HOMO and LUMO levels for the fullerene derivatives are denoted with arrow lines.

58. The LUMO level of TCNQ is about 4.5eV, as shown in Figure 14 of the 2007 Chemical Review article. EX2002-2007ChemReivew, Fig. 14.

59. That is, C_{60} 's and TCNQ's LUMO energy levels are below the ionization energy of $W_2(hpp)_4$, making the electron transfer from $W_2(hpp)_4$ to these compounds energetically favorable.

60. It was therefore not surprising that after Cotton, other research groups also studied doping of C_{60} with $W_2(hpp)_4$. *See* EX2003-2016-Chem-Rev at 13720 (citing references 121, 122 and 126 for using $W_2(hpp)_4$ as a dopant), 13746 (listing references 121, 122 and 126; the title for reference 122 indicates that it relates to doping of C_{60} and Reference 126 is the Cotton Science paper (EX2009); EX2016 (<https://onlinelibrary.wiley.com/doi/10.1002/pssa.201330049>) (abstract of Reference 121 indicates that authors studied C_{60} layer doped with $W_2(hpp)_4$). Likewise, the reported reaction between $W_2(hpp)_4$ and TCNQ can be explained by the fact that the LUMO energy level for TCNQ (about 4.5 eV, *see* EX2002-2007ChemReview, Fig. 14) is below the ionization potential of $W_2(hpp)_4$. But as of 2016, there had been no reported doping of BPhen or TAZ with $W_2(hpp)_4$, consistent with the large energy level differences which make doping difficult and the likelihood of success low.

61. In summary, given that the LUMO energy levels of BPhen and TAZ lie much higher than the HOMO of $W_2(hpp)_4$ (as reflected by its ionization energy) and that $W_2(hpp)_4$ was believed to donate electrons to organic materials by removing electrons from its HOMO for transfer into the LUMO of the organic

compound, a person of ordinary skill in the art would not view n-doping of BPhen or TAZ as an energetically favorable process or had a reasonable expectation that n-doping would be successful.

62. I understand that the '223 patent disclosed that doping BCP with $W_2(hpp)_4$ led to higher current densities. *See* '223 patent, 16:61-17:21. I understand that Samsung argues that this is evidence that a person of ordinary skill in the art would have had a reasonable expectation of success of doping BPhen or TAZ with $W_2(hpp)_4$. I understand that it is not appropriate to argue obviousness based on what the inventors did or observed. As I have explained above, without the teaching from the inventors, a POSITA would not think that $W_2(hpp)_4$ should be used to n-dope BPhen or TAZ with a LUMO lying much higher in energy than the ionization energy of $W_2(hpp)_4$. That the inventors demonstrated something unexpected is not evidence of obviousness without that foresight.

63. Moreover, the LUMO energy level of Compound V (or BCP) was reported to be 3.0- 3.1 eV. *See* EX2035, Fig. 10); EX2036 [164IPREX1016], Fig. 4.

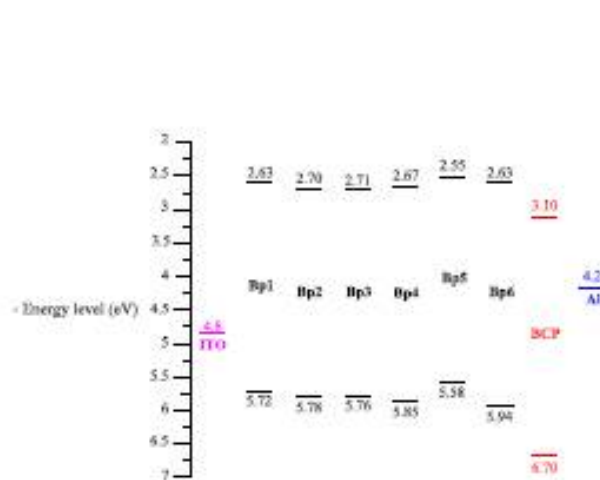


Figure 10. Comparison of the HOMO-LUMO energy levels of **P1-6** and those of BCP, indium tin oxide (ITO), and aluminum.

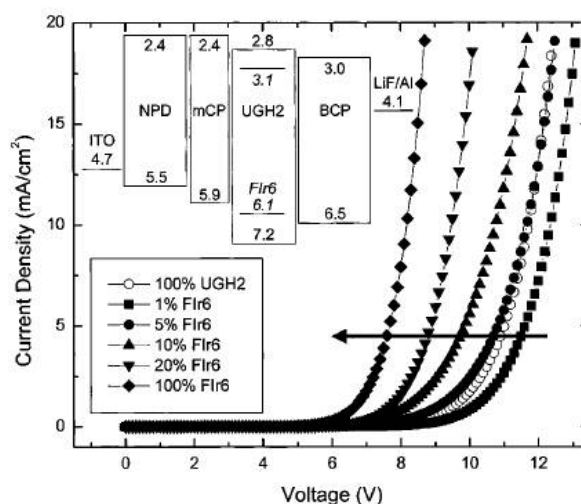


FIG. 4. $J-V$ characteristics for ITO/NPD (40 nm)/mCP (15 nm)/UGH2: $x\%$ Flr6 (25 nm)/BCP (40 nm)/LiF (0.5 nm)/Al (50 nm) OLEDs. The arrow points in the direction of increasing Flr6 concentration. Inset: Proposed energy level scheme for the device under zero applied bias.

64. If BPhen's LUMO level is 2.5eV, then BPhen's and TAZ's LUMO levels are about 0.5-0.6 eV and 0.3-0.4 eV respectively above the LUMO level of BCP. If so, then the fact that the inventors succeeded in doping BCP with $W_2(hpp)_4$ also would not suggest to a person of ordinary skill in the art that they would have a reasonable likelihood to be able to dope BPhen or TAZ with $W_2(hpp)_4$ given the larger difference between the ionization energy of $W_2(hpp)_4$ and the LUMO energies of BPhen and TAZ, which makes n-doping energetically less favorable for BPhen and TAZ. But even if the LUMO level of BCP is about the same as that of BPhen, the fact that the inventors succeeded in using $W_2(hpp)_4$ to dope BCP does not mean that a person of ordinary skill in the art, without the creativity and insight of the inventors, would have done the same or had a reasonable expectation that the doping would be successful given the large

difference between the ionization energy of $W_2(hpp)_4$ and the LUMO energies of BPhen and TAZ.

65. Samsung may argue that a person of ordinary skill in the art would have expected success because alkaline metals such as Li had been used to n-dope phenanthrolines and the known ionization energy of these metals are lower than $W_2(hpp)_4$. *See* EX2009_2002CottonScience, 1971 (“Lithium and sodium atoms have ionization enthalpies above 5 eV (5.39 and 5.14 eV, respectively), and only the heavier alkali metals have ionization enthalpies less than 5 eV, with the cesium atom having the lowest of all the elements at 3.89 eV[.]”).

66. But alkaline metals were thought to dope BPhen through a different mechanism, one via improving electron injection in OLED. *See* EX2002_2007ChemReview, § 2.2 (list “three different approaches to obtain efficient n-type doping,” first being “the use of alkali metals, which has [sic] frequently been used to improve electron injection in OLEDs” and second being “the search for new molecular compounds that have extremely high-lying HOMOs”; use of $W_2(hpp)_4$ is an example of the second approach). The exact mechanism was not clear and could be complicated. *Id.*, 1244-45, § 2.2.1.

67. However, when metals of low work function improve electron injection into electron transporting layers, that was thought to be “due to the good match of their work functions with the lowest unoccupied molecular orbital level

of the ETL.” EX2010_2008JAppPhys, 104502-1. “The widely measured work function of lithium is about 2.95-3.1 eV,” (*see* EX2037_2016_SEI_tunneling_JPS, 225), though some put it as low as 2.49 eV or so (*see* EX2038_1949PhyReview, abstract). This energy range, from about 2.5eV to about 3.1eV, matches well with the reported BPhen LUMO energy level (2.5-3.0eV). In other words, when phenanthroline is doped by an elemental metal such as Li, the relevant parameter is the work function of the metal, and not its ionization energy. Additionally, as even the brief summary in the 2007 Chemical Review article indicates, the exact doping pathway with alkali metal was unclear, and there could be other factors that make the doping energetically more favorable. EX2002, 1244-45. But none of those factors appear at issue for n-doping using molecules with high-lying HOMOs, such as $W_2(hpp)_4$. That is, the successful doping of an organic material with Li would not indicate to a person of ordinary skill in the art that the same would be expected with a molecular dopant $W_2(hpp)_4$.

68. $W_2(hpp)_4$ was also reported to destroy organic compounds. For instance, the Cotton group reported that when $W_2(hpp)_4$ reacted with methylene chloride, it formed $W_2(hpp)_4Cl_2$, indicating that the CH_2Cl_2 molecule was destroyed in the reaction. EX2008_Cotton_Inorganic_Chem_Comm, 123-124.

69. Werner, however, states that it has “the object of specifying metal complexes as n-dopants for doping an organic semiconducting matrix material, ...

without adverse effects on the matrix material, ...” EX1005-5:21-28. A reagent that would potentially destroy a small molecule is not one that would be expected to be used “without adverse effects on the matrix material.” Hence, given Werner’s stated object and $W_2(hpp)_4$ ’s known property, a person of ordinary skill in the art would be wary of combining $W_2(hpp)_4$ with small organic molecules such as BPhen and TAZ.

70. In summary, Samsung and its expert do not appear to have considered the specific electronic properties of the organic compounds and metal complexes, and used instead the 223 patent’s disclosure as a roadmap to cherry-pick $W_2(hpp)_4$ and BPhen/TAZ. Without the inventors’ teaching, however, it is my opinion that a person of ordinary skill in the art would not have chosen those specific combinations, especially in light of the differences in the organic complexes’ LUMO energy levels and the ionization potential of $W_2(hpp)_4$.

D. Forming an Electron Conducting Layer using $W_2(hpp)_4$ with BPhen or TAZ

71. As noted above, the reported LUMO energy levels of BPhen and TAZ were much higher than the reported ionization energy of $W_2(hpp)_4$ in the gas phase. A person of ordinary skill in the art therefore would not have had a reasonable expectation of success to obtain an n-doped layer of BPhen or TAZ that is electrically conductively connected to at least one of the electrodes. For instance,

there is no evidence that a person of ordinary skill in the art would have regarded BPhen or TAZ as an effective electron acceptor to $W_2(hpp)_4$ like CH_2Cl_2 , TCQN and fullerene. EX2008, 124 (Cotton explaining that CH_2Cl_2 was known to be reducible via generation of free radicals, and C_{60} and TCQN are two other well-known reducible species). There was no such knowledge regarding the oxidizing capabilities or reducibility of BPhen and TAZ.

E. Co-Evaporation of $W_2(hpp)_4$ with BPhen or TAZ

72. Werner also does not suggest using joint evaporation to combine BPhen or TAZ with $W_2(hpp)_4$. In particular, in the section “Implementation of doping,” Werner lists five doping methods, and only one of them is “[c]o-evaporation in vacuum with a source for the matrix material and one for the dopant.” EX1005-59:13-30. In the “Application examples,” when Werner states that “[t]he provided metal complex is evaporated simultaneously with the matrix material,” he also states that “the matrix material is phthalocyanine-zinc or fullerene C_{60} ” in those examples. EX1005-64 (“Application Examples”), EX1005-64:10-12 (describing methods for the application examples). Thus, reading Werner as a whole does not suggest to a person of ordinary skill in the art to jointly evaporate $W_2(hpp)_4$ with BPhen or TAZ.

73. Furthermore, even in those application examples, a person of ordinary skill in the art would recognize that the metal complex and the matrix material are

not all evaporated simultaneously. In Example 3, for example, “a pure layer of the fullerene was produced by sublimation in high vacuum” at first. EX1005-65:25-26. It is clear from the context that fullerene was not doped until “cobaltocene was thermally sublimated” and “deposited on the surface of the fullerene layer [to] form[] a thin highly doped layer there.” EX1005-65:24-31 (“A layer of fullerene C₆₀ was doped with the metal complex cobaltocene. First, a pure layer of fullerene was produced by sublimation in high vacuum. ... The doped layer was then placed in a container containing an evaporator filled with cobaltocene. The container was filled with nitrogen. The cobaltocene was thermally sublimated in this container. The cobaltocene deposited on the surface of the fullerene layer formed a thin highly doped layer there.”). That is, fullerene and cobaltocene were deposited in sequence, not simultaneously, following method (b) for “Implementation of doping.” EX1005-59:19-21 (“Sequential deposition of the matrix material and the n-dopant on a substrate with subsequent diffusion of the dopant, in particular through thermal treatment”). Hence, Werner as a whole suggests that the specific method of deposition would depend on matrix materials and metal complexes, and does not suggest that W₂(hpp)₄ should be jointly evaporated with BPhen or TAZ.

74. At the time of the invention, the only reported reactions with W₂(hpp)₄ were all carried out in solutions. For instance, the Cotton group explored the use of W₂(hpp)₄ as a strong reducing agent with methylene chloride (CH₂Cl₂),

fullerene C₆₀, and TCQN. Reducing a material means electrons are donated from the reducing agent (e.g., W₂(hpp)₄) to the matrix materials, a process that can lead to doping of the matrix materials. But all the reactions took place in solutions. EX2008, 122 (see “Experimental” section: reaction between W₂(hpp)₄ and CH₂Cl₂ is carried out in CH₂Cl₂, a common solution; reaction with C₆₀ was carried out in a toluene solution; and reaction with TCQN is in a THF solution).

75. The Cotton group concluded that W₂(hpp)₄ “is a strong reducing agent with an enormous potential for use on organic substrates *in organic solvents*.” EX2008 at 124. And they recommended exploring using W₂(hpp)₄ in “chemistry in living organisms.” *Id.* at 125. Studies for living organisms are done in liquid phase, not gaseous phase. That is, at the time of the invention, the art does not disclose, suggest or provide any motivation to react W₂(hpp)₄ with an organic compound in gas phase, let alone through co-evaporation.

F. Coordination of BPhen or TAZ to the Tungsten Metal Center in W₂(hpp)₄

76. Samsung posits that a person of ordinary skill in the art would have understood that W₂(hpp)₄ could coordinate with additional ligands, such as BPhen or TAZ. But while some tungsten complexes could coordinate additional ligands, (see EX2004-Cotton-textbook, p.187 (noting that ditungsten carboxylates W₂(O₂CR)₄ has the ability to form axial adducts), the crystal structure of W₂(hpp)₄

did not show coordination of any solvent complexed to the axial positions of the tungsten centers (*see* EX2008, 123).

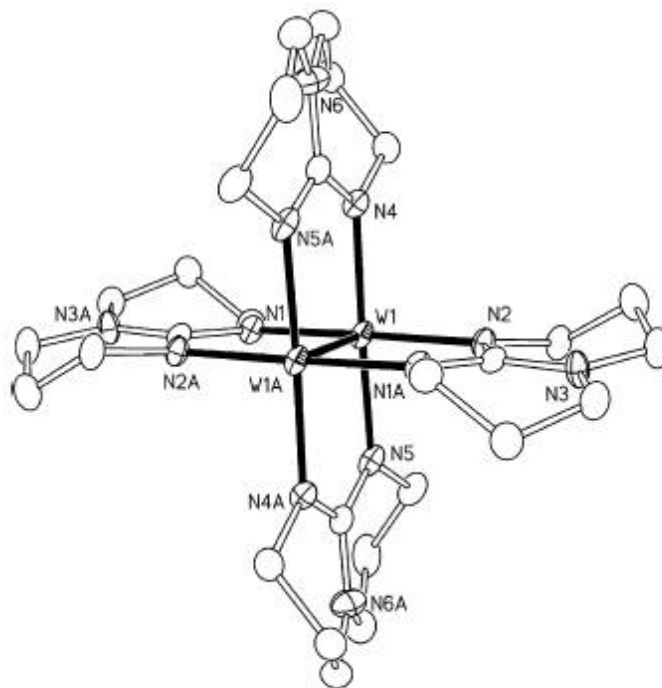


Fig. 1. An ellipsoid plot of $W_2(hpp)_4$, I, with atoms drawn at the 30% probability level. All hydrogen atoms have been omitted for clarity.

77. And upon reacting with CH_2Cl_2 , $W_2(hpp)_4$ is oxidized to $W_2(hpp)_4Cl_2$. Even though an oxidized tungsten center should be less electron rich (because it has lost electrons) and therefore has more propensity to bind to ligands, the crystal structure still revealed a fairly long W-Cl bond, indicating that the chloride ions are fairly distant from the tungsten centers. EX2008 at 124. The “long W...Cl separations” “indicat[e] that there is no significant axial bonding.” *Id.*

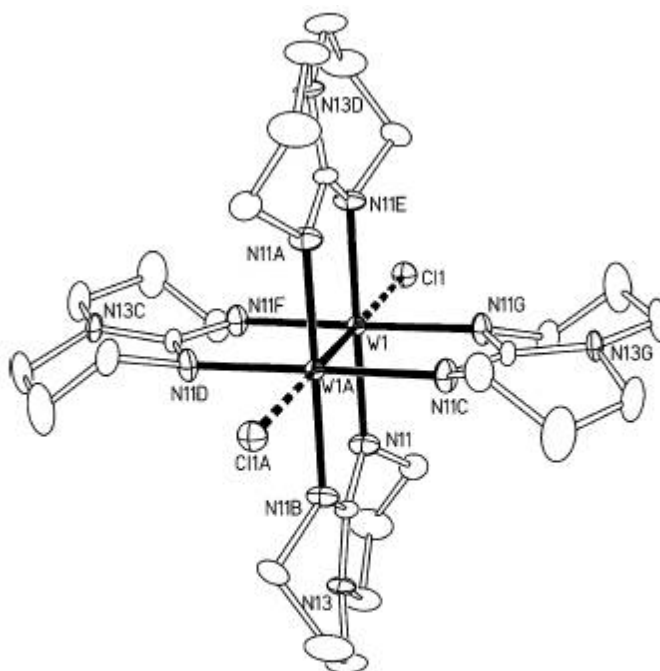


Fig. 2. Displacement ellipsoid plot of one orientation of the disordered $W_2(hpp)_4Cl_2$ molecule in $2 \cdot 4CH_2Cl_2$. Atoms are drawn at the 30% probability level. Hydrogen atoms have been omitted for clarity.

78. A person of ordinary skill in the art would understand that there is effectively no coordination to the empty coordinate site of the tungsten atom by the chloride ion. Hence, the crystal structures of $W_2(hpp)_4$ and $W_2(hpp)_4Cl_2$ do not suggest to a person of ordinary skill in the art that BPhen or TAZ would coordinate to the tungsten centers in the electron rich $W_2(hpp)_4$ or $W_2(hpp)_4Cl_2$. Instead, they would suggest no binding of these ligands to the tungsten center.

79. The coordination of electrophilic (electron poor) $Rh_2(O_2CCF_3)_4$ with hexamethylbenzene does not suggest that similar coordination would occur in the electron rich ditungsten compound. Rather, a person of ordinary skill in the art

would understand that $\text{Rh}_2(\text{O}_2\text{CCF}_3)_4$ and $\text{W}_2(\text{hpp})_4$ complex have completely different electronic and likely steric properties.

80. Unlike the electron rich $\text{W}_2(\text{hpp})_4$, the metal centers in $\text{Rh}_2(\text{O}_2\text{CCF}_3)_4$ are electron deficient because the trifluoroacetate ligand is understood to be highly electron withdrawing. The rhodium center was therefore understood to be electrophilic and would more readily accept pi-electron donation from the aromatic rings.

81. When tungsten is coordinated to carboxylates with electron-withdrawing substituents, its axial positions can also coordinate to electron-donating solvent molecules, such as THF, though there is no report of arene-adducts with tungsten carboxylates. See EX2004_Cottonbook, 187-188.

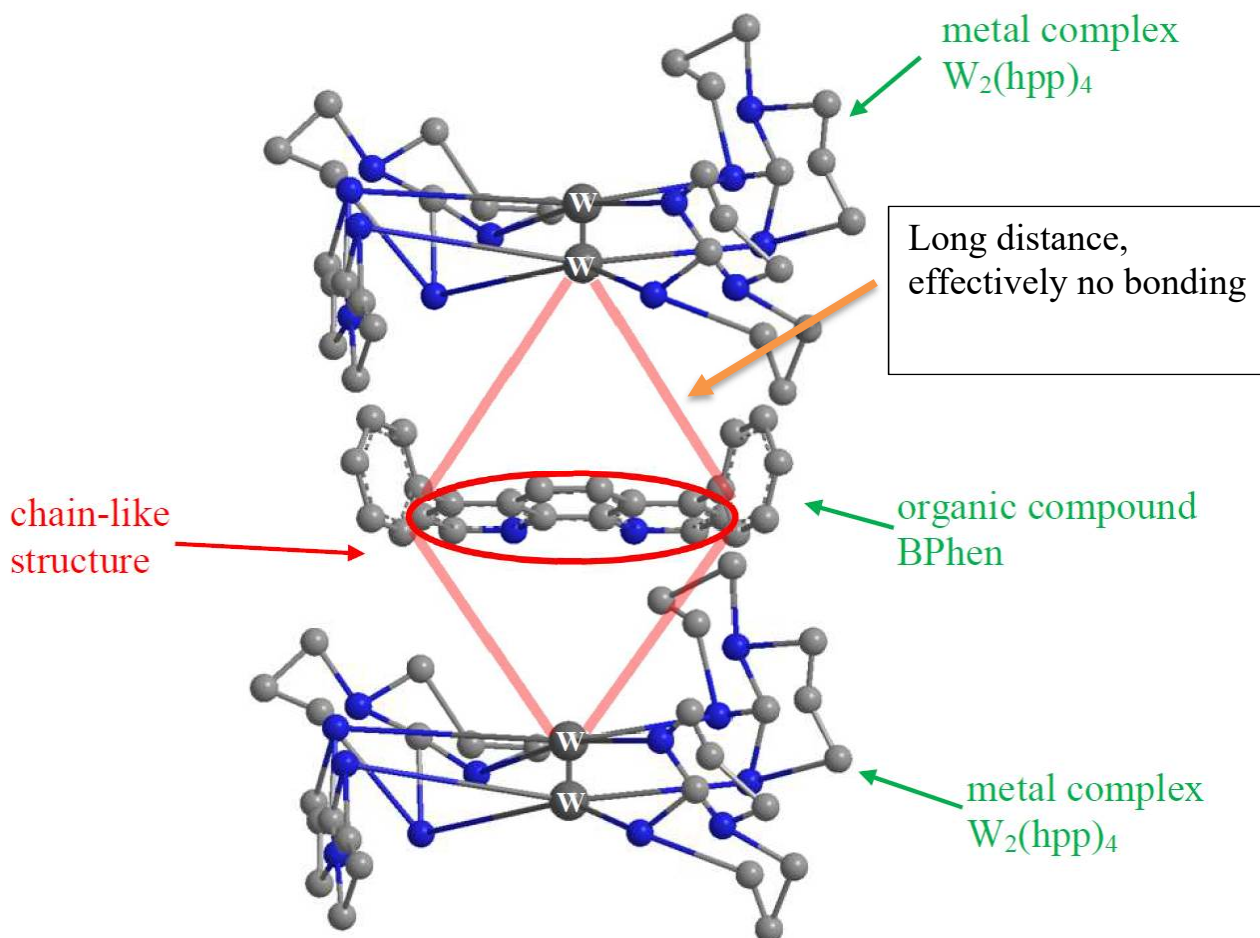
82. The δ ionization of $\text{W}_2(\text{O}_2\text{CCF}_3)_4$ appears at 7.39 eV. In contrast, the gas phase ionization of $\text{W}_2(\text{hpp})_4$ starts at 3.51 eV. EX2004_Cotton_textbook, 186, 189. This demonstrates that the ligands have a profound effect on the electronic properties of the metals, making the metal center more electrophilic or more electron rich.

83. Hence, given that $\text{W}_2(\text{hpp})_4$ is very electron rich compared to $\text{Rh}_2(\text{O}_2\text{CCF}_3)_4$ or even $\text{W}_2(\text{O}_2\text{CCF}_3)_4$, a person of ordinary skill in the art would not expect $\text{W}_2(\text{hpp})_4$ to coordinate to aryl rings to accept electrons. That is because it is already electron rich and does not need to receive electrons from a weak-donor

like aryl rings. Thus, a person of ordinary skill in the art would not expect the electron rich tungsten metal centers in $W_2(hpp)_4$ to behave like the electrophilic $Rh_2(O_2CCF_3)_4$ or to coordinate to pi-bonds to further increase its electron density.

84. Moreover, $O_2CCF_3^-$ is a much smaller ligand than hpp, leaving the metal centers more exposed (less sterically encumbered) and allowing the aromatic ring to approach the metal center and coordinate to it via the π -bond. The electron rich $W_2(hpp)_4$, on the other hand, has the four more bulky hpp ligands surrounding the metal center.

85. Thus, if Dr. Rand's depiction below was even a possibility, it would indicate to a person of ordinary skill in the art that the steric hindrance around the tungsten centers renders the coordination around tungsten unfavorable. Specifically, the cyclohexyl rings of the hpp ligands would repel the phenyl ring, increasing the distance between tungsten and the phenyl ring. This would mean that there is effectively no coordination (electronic interaction) between the W metal center and the phenyl ring.



86. The bonding strength between W's π^* -orbital and the aryl ring's π -electrons drops off exponentially as the distance between the metal center and the aromatic ring increases. As such, a person of ordinary skill in the art would not view a configuration above, with the tungsten center and the aryl ring far apart, as involving coordination of BPhen to the tungsten center.

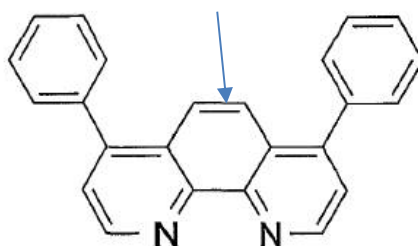
87. In summary, given the state of art, a POSITA would not have viewed that BPhen or TAZ would coordinate to the ditungsten atoms, certainly not in the manner suggested by Samsung.

G. A Person of Ordinary Skill in the Art Would Not Expect BPhen or TAZ to Form Chain-Like or Network-Like Structure with $W_2(hpp)_4$

88. As explained above, at the time of the invention, a person of ordinary skill in the art would not have expected BPhen to coordinate to the $W_2(hpp)_4$ given the electron richness of the tungsten center. It certainly would not coordinate to BPhen in the manner suggested by Samsung to form chain-like or network-like structures.

89. A person of ordinary skill in the art would also have expected that if BPhen coordinates to a metal center, the two nitrogen atoms of BPhen would coordinate to the same metal center, instead of coordinating to two different metal centers. This is because the two nitrogen atoms are tethered together by a rigid, fused aromatic ring and the two nitrogen atoms are therefore fixed in positions.

Aromatic ring tethers the two N's



BPhen = bathophenanthroline
 (4,7-Diphenyl-1,10-phenanthroline)
 $C_{24}H_{16}N_2$

90. This geometry makes the two nitrogens in BPhen more suitable to form a relatively stable five membered ring around a same metal center if the metal would coordinate to it in the first instance. For example, for instance, in a 2005 paper, researchers examined the coordination chemistry of a bis-phenanthroline compound 1 (biphen), among others, with copper(I). See EX2028 _Heterocycles 2005, abstract, 552.

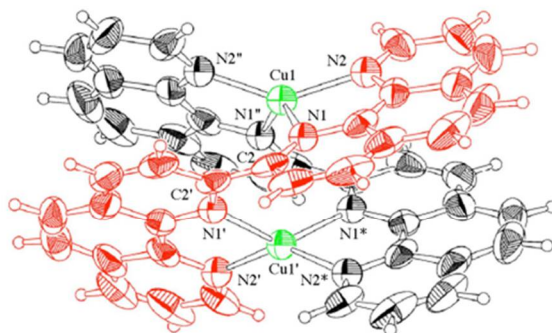


Figure 4. ORTEP drawing of $[Cu_2L_2](PF_6)_2$. Counter anions are omitted for clarity. Four phen units are all related to symmetric operations.

91. The crystallography of the isolated products show the structure above. EX2028, 556. In the compound, the two nitrogen atoms on the same

phenanthroline ring coordinate to the same copper center, and the two phenanthroline rings in the same molecule coordinate to different single-nuclear copper centers. The crystal structure also does not show any Cu- π -system interactions.

92. Paddlewheel structures formed by bipyridine ligands also strongly suggest that the two nitrogen atoms of BPhen would bind to a single metal center. In bipyridine compounds, two bipyridyl rings are linked together through a C-C single bond, which actually affords it with more degrees of rotational freedom than the fused BPhen ring. Nevertheless, even with that degree of freedom, bipyridyl ligands bind to a single Rh center in Rh₂ paddlewheel structures. *See* EX2018-Crawford-1997, Figs. 1-3; EX2017-Crawford1993, Figs. 2-4.

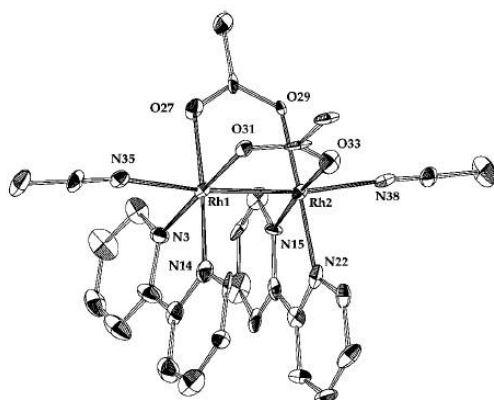


Figure 1. ORTEP representation of the cation of complex 6a at the 50% probability level. Carbon atoms are numbered sequentially around from N and O atoms.

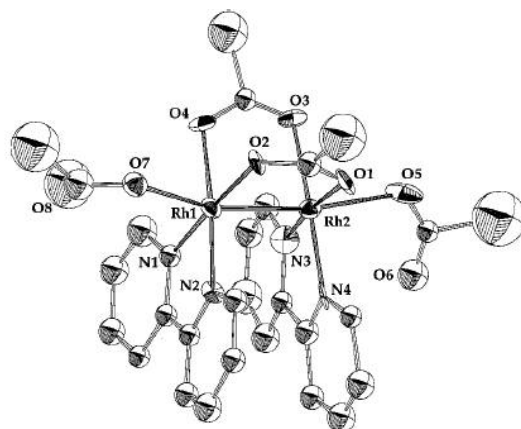


Figure 2. ORTEP representation of complex 9; F atoms are omitted for clarity.

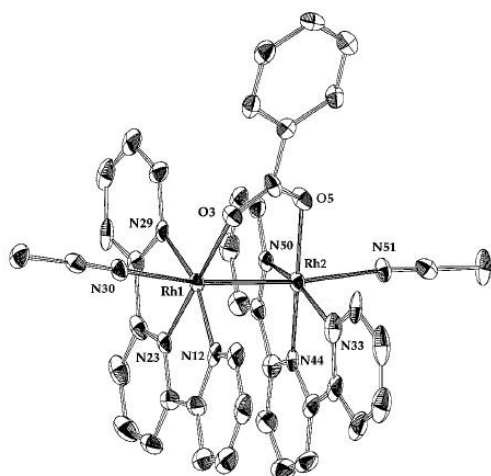


Figure 3. ORTEP representation of the cation of complex 16 at the 50% probability level. Carbon atoms are numbered sequentially around from N and O atoms, and hydrogen atoms have been omitted for clarity.

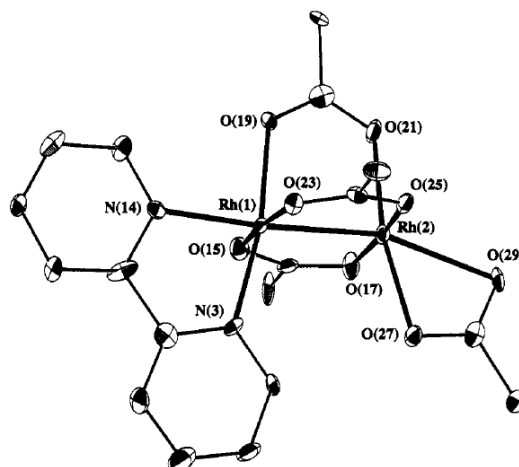


Figure 2. ORTEP representation of complex 3 at the 50% probability level. Carbon atoms are numbered sequentially clockwise from N(3) to N(14). Other carbon atoms are numbered sequentially from labeled atoms.

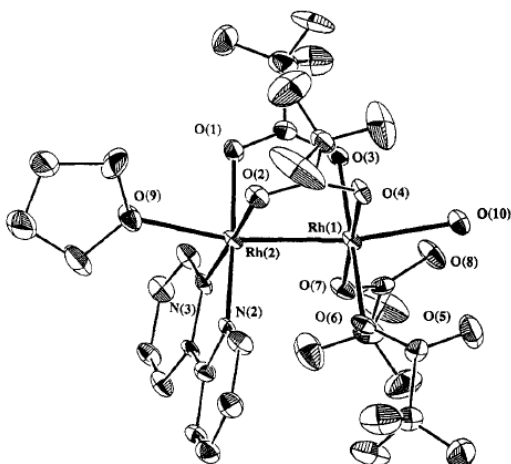


Figure 3. ORTEP representation of complex 5 at the 50% probability level. Carbon atoms C(8)–C(17) and C(19)–C(22) belong to bpy and THF rings, respectively. The other carbons are carboxylate atoms.

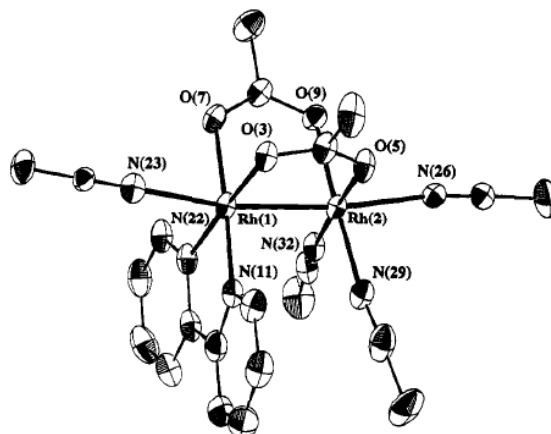
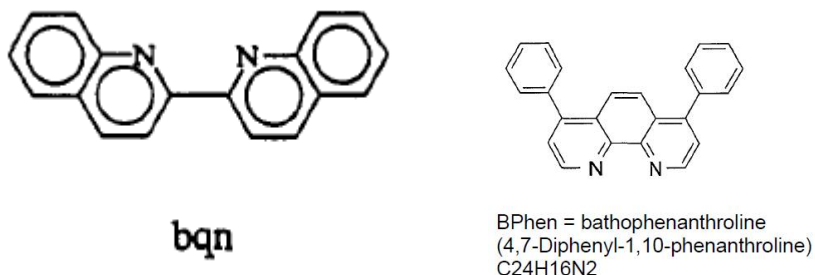


Figure 4. ORTEP representation of $[\text{Rh}_2(\text{OAc})_2(\text{bpy})(\text{MeCN})_4]^{2+}$, the cation of complex 7, at the 50% probability level. Carbon atoms are numbered sequentially clockwise from N(11) to N(22). Other carbon atoms are numbered sequentially from labeled atoms.

93. Also notable is the authors' observation that no ligation occurred with bqn, a complex with more rigid ring system, to form a paddlewheel structure (the type of structure that Samsung suggests would form in the ditungsten complex). EX2017-1993Crawford, 3132-33. The authors surmised that there were steric repulsions between the fused rings of bqn and the existing ligands on the Rh centers that hinder bqn from approaching the axial position of the Rh centers. *Id.*



94. bqn may be regarded as a good model compound to assess BPhen's ability to form paddlewheel complexes given the rigidity of its fused rings. The steric repulsions bqn experienced from the existing ligands of the Rh center provide a good indication of the steric repulsions that BPhen would experience when it approaches the W center in W₂(hpp)₄. That is, prior art would indicate to a person of ordinary skill in the art that a rigid compound like BPhen is unlikely to coordinate to a metal center with a paddlewheel structure.

95. This supports Pictiva's theory and the 223 patent's teaching that two heteroaromatic rings linked by C-C single bonds and spacer moieties can facilitate

coordination to different metal centers. But this does not support Samsung's theory that a person of ordinary skill in the art would expect the two nitrogen atoms on the same phenanthroline ring to bridge two different metal centers, or in the case of a paddlewheel complex, any metal center.

96. Other studies also consistently showed that *when and if* BPhen coordinates to a metal complex, the two nitrogens in the phenanthroline ring would coordinate to the same metal center.

97. For example, in EX2029, it was shown that the two nitrogens in the phenanthroline moiety coordinate to the same single-nuclear Mn(II) metal center. EX2029, abstract. Additional examples showing the same coordination chemistry can be seen from EX2030 Fig. 1 (each phenanthroline ring coordinates to the same Fe(II) metal center); EX2031 (each phenanthroline ring coordinates to a Ni(II) or Fe(II) center); EX2032 (each phenanthroline ring coordinates to a Ru(II) center).

98. Thus, given the state of the art at the time of the invention and the knowledge of BPhen coordination to metal centers, when a person of ordinary skill in the art wanted to form a chain-like structure between a metal complex and an organic compound with the claimed structure, they would not have chosen BPhen because BPhen, if it coordinates to a metal center, it would coordinate to only a single metal center and not two metal centers. Additionally, as I noted above,

BPhen is unlikely to form a paddlewheel structure given its structural rigidity and the consequent steric repulsions with the hpp ligands on the tungsten metal center.

99. A person of ordinary skill in the art also would not have performed the reaction with $W_2(hpp)_4$ in gas phase as opposed to in an inert solution, because at the time of the invention, only solution-based reactions had been reported for $W_2(hpp)_4$.

100. Samsung also argues that “a POSA would have been motivated to combine Method (a) [joint evaporation] and Method (e) [solution-based process] ... to prepare a mixture of matrix material and dopant” Pet. 41. Samsung argues that this “would allow for $W_2(hpp)_4$ and BPhen to be in close proximity in the gas phase, so as to allow for BPhen to bridge two (or more) $W_2(hpp)_4$ molecules” *Id.* I do not understand the logic behind this conclusion.

101. By dissolving the metal complex and the BPhen in a solution and then vaporizing the resulting mixture, the possibility for a $W_2(hpp)_4$ molecule to collide with BPhen decreases significantly as $W_2(hpp)_4$ will more likely collide with a solvent molecule existing in much higher numbers than the solute BPhen. For example, Professor Cotton explained that $Rh_2(O_2CCF_3)_4$ were prepared using sublimation-deposition to avoid having solvent molecules compete with weak donor ligands for axial coordination. EX2004_Cottonbook, 467. This would suggest to a POSITA that solvents suppress rather than promote coordination of

ligands to the metal center. That is, the use of solvents reduces, and not increases, the likelihood of $W_2(hpp)_4$ coordinating to BPhen due to joint vaporization.

102. A person of ordinary skill in the art therefore would not have combined co-evaporation and solution based process, as Samsung suggests, because it would not lead to better ligand coordination due to joint vaporization. A person of ordinary skill in the art would also understand that, even though Werner claims that the different methods may be combined, these methods are not modular, and cannot be combined at will.

103. Samsung also argues that a POSITA would have evaporated $W_2(hpp)_4$ and BPhen from a single crucible as opposed to two crucibles. Pet. 41-44. Even if true, that does not change the fact that at the time of the invention, there was no suggestion of using evaporation to react or dope an organic compound with $W_2(hpp)_4$.

104. Additionally, Samsung and its expert do not explain how a person of ordinary skill in the art could control the respective rates of deposition for $W_2(hpp)_4$ versus BPhen, given their disparate enthalpy of evaporation. When evaporating from two different sources, each source can be controlled independently with different temperatures, for example, to control the deposition rates.

105. The Werner II reference does not support Samsung's conclusion that $W_2(hpp)_4$ and BPhen could be deposited from a single source. Specifically, Werner II targets co-deposition of materials whose "sublimation/vaporization temperatures ... differ by less than approximately 50° C, preferably less than approximately 20° C." EX1009, [0021]; *see also* [0032] (mixture of tetracene and tetrafluoro-tetracyano-quinodimethane), [0034] (mixture of two organic compounds NTCDA and LCV). There is no evidence that $W_2(hpp)_4$ and BPhen (or TAZ) are such a pair.

106. Moreover, Werner II warns against mixing strong donor-acceptor charge-transfer pairs. For example, co-evaporation of premixed m-MTDATA and F4-TCNQ was either unsuccessful or no doping occurred. *Id.*, [0039]-[0041], [0043]-[0044]. F4-TCNQ, a strong electron acceptor, was a known p-dopant for m-MTDATA. EX2019, abstract (describing an OLED device with an F4-TCNQ-doped m-MTDATA layer). Thus, if as Samsung argues, $W_2(hpp)_4$ and BPhen was expected to react, a person of ordinary skill in the art who had read Werner II as a whole would not have premixed them in light of Werner II's warning, contrary to Samsung's argument.

107. Samsung also argues that a POSITA would have modified deposition parameters to obtain "a more uniform layer of coordinated BPhen and $W_2(hpp)_4$ " to "allow for the more efficient transfer of electrons through that layer." Pet. 44.

That understanding, however, would have come from the inventors. EX1001, 1:60:2:16. For example, the inventors teach that “[t]he compounds are deposited in the coordinated state, so that a layer is formed, in which a short-range order is provided.” *Id.*, 1:64-66. The inventors then explain that “[b]y virtue of the coordination of the organic compound on the metal complexes, and the associated overlap of the orbitals, additional electrons can be transferred from the metal to the ligand via a metal complex-ligand-electron transfer[.]” *Id.*, 2:6-10. “These electrons can be available for electron transportation in the organic electronic component,” and “[b]y increasing the ‘free’ electrons, the electron conductivity in the component is significantly improved.” *Id.*, 2:11-14. “This leads to an increase in efficiency and serviceable life of the organic electronic component.” *Id.*, 2:14-15. Thus, the stated reason for making the modification did not come from the prior art, but from the inventors’ insight.

108. Samsung also urges the use of low vacuum to evaporate $W_2(hpp)_4$ and BPhen, citing the Shtein paper. Pet. 44-45. The Shtein paper, however, describes depositing a single material, not a mixture of materials. EX1008, 4012 (“Experiment”: depositing “thin films of Alq_3 ”). There is no evidence that the method would have worked with a mixture of materials with substantially different sublimation or vaporization temperatures. In fact, before the inventors disclosed

their results, reported reactions with $W_2(hpp)_4$ all took place in solution. *See* EX2008.

109. Samsung argues that OVPD's higher vapor pressure could facilitate the coordination chemistry. A person of ordinary skill in the art would not have expected OVPD to facilitate coordination. In OVPD, "a hot, nonreactive carrier gas is used to transport an organic vapor toward a cooled substrate onto which the organic materials condense." EX1008, 4006. Under the OVPD condition, both the metal complex and the BPhen molecule would thus encounter inert gas molecules existing in far larger numbers. The metal complex and BPhen would then collide more frequently with the inert gas molecules that are present in far large numbers, resulting in fewer, rather than more, productive collisions between BPhen and $W_2(hpp)_4$.

110. In summary, at the time of the invention, there was no evidence that a person of ordinary skill in the art would have expected BPhen to coordinate to more than one metal center if at all, or that they could have reacted BPhen with $W_2(hpp)_4$ through vaporization as opposed to a solution-based approach that was done for all the $W_2(hpp)_4$ -based reactions up to that point.

H. Werner Does Not Disclose or Suggest Cross-Linking

111. Werner does not mention forming chain-like or network-like structures between its metal complexes and matrix materials. Werner also does not

mention cross-linking. And neither Samsung nor its expert has pointed to anything in the prior art that taught “the degree of cross-linking is related to electron conductivity and that the ratio between the metal complex and the organic compound during vaporization affects the electron conductivity of the electron-conducting layer.” Pet. 53.

112. It is my opinion that the above-stated knowledge came from the inventors. See Pet. 52-53 (citing the 223 patent’s disclosure for the teaching that “[t]he formation of chain-like or network-like structures enable additional electrons to be able to be transferred from the metal complexes to the organic compounds”). And because others did not have the inventors’ insight, they would not have had any reason to modify reaction conditions to adjust the cross-linking density.

113. Moreover, as I explained above, BPhen is not even likely to bind to $W_2(hpp)_4$ that has a paddlewheel structure because the steric repulsion between the rigid fused ring system and the bulky hpp ligand would prevent BPhen from approaching the axial position to coordinate, similar to what is observed for a Rh2-complex. See EX2017-1993-Crawford, 3132-33.

V. The Ma Reference

A. *Synthetic Metals* Journal

114. I have been asked to provide some background information regarding *Synthetic Metals*, the journal in which the Ma reference was published.

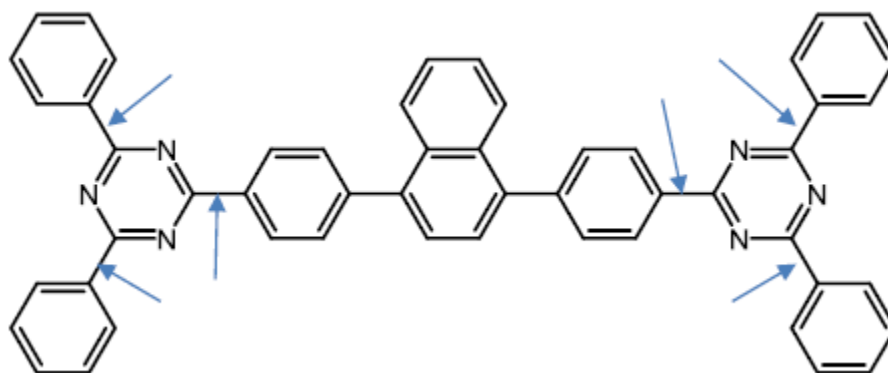
115. *Synthetic Metals* is a journal published by for-profit publisher Elsevier. While popular in the 1980s and early 1990s, as more researches and resources were devoted to optoelectronics, many journals of higher calibers with an emphasis on optoelectronics-related research had been established. By 2008/2009, *Synthetic Metals* had long ceased to be a journal that researchers in optoelectronics would actively monitor for new articles.

116. Additionally, as I recall, in 2008-2009, Elsevier journals often did not promptly index new articles, especially online-only versions. Thus, it was my recollection that new articles often could not be located unless one knew the author's names or the title of the article. It is also my recollection that in 2008-2009, Elsevier's search tool⁵ had limited keyword search capability as it often failed to identify articles of interest. Additionally, during the relevant time period (2008-2009), indexing services, such as Clarivate Web of Science did not index online only articles, making them difficult or impossible to locate.

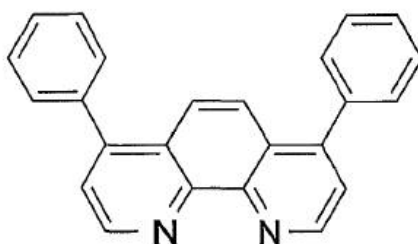
B. BPhen versus Bistriazine Compound Used in Samsung Products

117. I have been asked to comment on the chemical properties of BPhen and the bistriazine compound below.

⁵ It was my recollection that Elsevier used similar search tools for its various journals in 2008/2009.

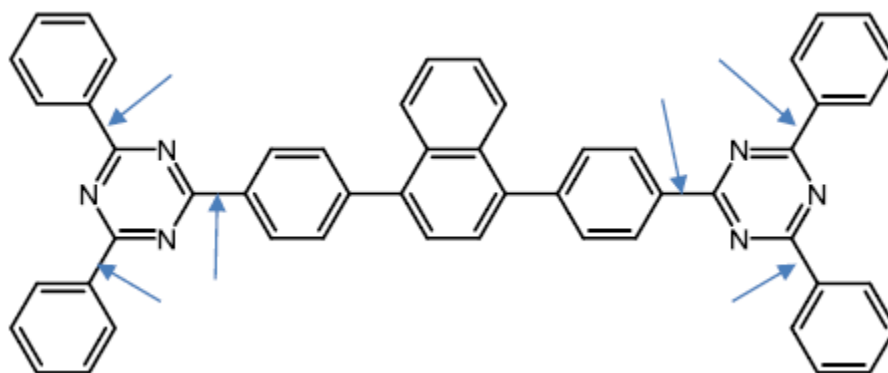


118. As I have noted above, in BPhen, the two nitrogen atoms in the phenanthroline ring are tethered by the rigid and fused aromatic backbone such that they are relatively fixed in place and configured to form a stable five-membered ring around a single metal center, if the steric and electronic properties of the metal and ligand match (that is, if the metal center is not shielded by bulky ligands to hinder approach by the BPhen ligand and the metal center has the right energy level and orbital symmetry to interact with BPhen's HOMO or LUMO).

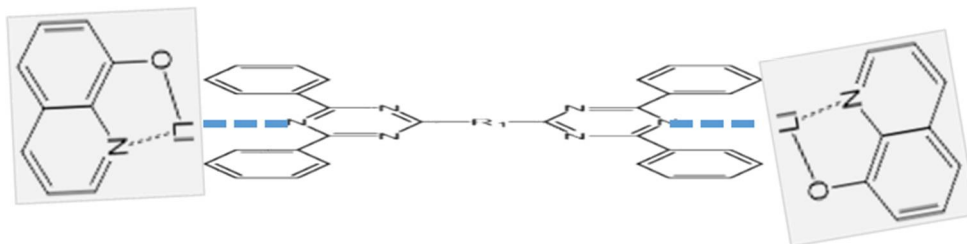


BPhen = bathophenanthroline
(4,7-Diphenyl-1,10-phenanthroline)
C₂₄H₁₆N₂

119. This differs from a ligand with two nitrogen-containing rings spaced apart by a chain of aromatics that can freely rotate around the C-C single bonds.



120. In the above ligand, each of the triazine rings can coordinate to at least one separate metal center, as illustrated below.

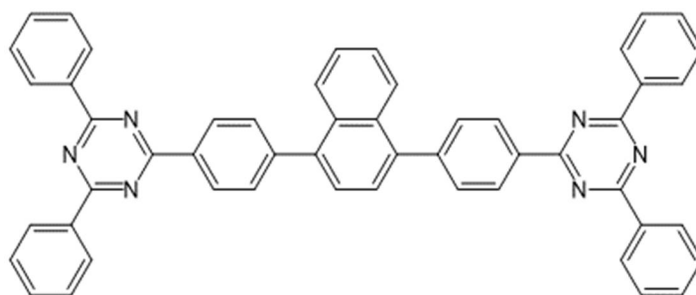


(Note, the Liq molecule likely approaches the ligand at an angle to the plane defined by the triazine ring for at least steric reasons and likely also to maximize molecular orbital overlap with the pair of electrons on nitrogen.)

121. The two nitrogen atoms in BPhen, on the other hand, would coordinate to the same metal center rather than different metal centers because the rigid vinylene backbone anchor the two nitrogen atoms in a relatively fixed position such that the two nitrogen atoms can form a relatively stable five-membered ring with a metal center, rather than each coordinating to a different

metal (if the pyridyl nitrogen would coordinate to the metal center in the first instance), as explained in ¶¶ 89-98 above.

122. As such, I agree with Pictiva that its assertion that the bistriazine complex can form a chain structure with Liq does not mean BPhen can do the same.



123. This is because, in contrast to the structure above, where the two triazine rings are spaced apart by C-C single bonds and spacer aromatic rings, the geometry of the two nitrogen atoms in the rigid, fused heteroaromatic ring makes coordination of BPhen to a single metal center more favorable; and the close proximity of the two nitrogen atoms also makes it sterically difficult for the second nitrogen to coordinate to a different metal center.

124. The coordination sphere, such as steric effects of the heteroaromatics are therefore quite different between BPhen and the triazine compound use in the Accused Products.

C. BPhen Coordination to Liq

125. Samsung suggests that Liq would form an arene adduct like $\text{Rh}_2(\text{O}_2\text{CF}_3)_4$. As I have explained above, the trifluoroacetate ligand ($^-\text{O}_2\text{CCF}_3$) was known to be highly electron withdrawing, such that rhodium is highly electrophilic (that is, it tends to accept electrons from an electron donor). On the other hand, the six methyl groups in hexamethylbenzene (C_6Me_6) increases the electron density of the pi-system of the phenyl ring. This makes the sharing of the pi-electrons through the electron-deficient rhodium's π^* -orbital (formed from anti-bonding interactions of d_{xz} - d_{xz} and d_{yz} - d_{yz}) thermodynamically very favorable in $\text{Rh}_2(\text{O}_2\text{CF}_3)_4$.

126. Liq, on the other hand, is regarded as an n-dopant for BPhen. An n-dopant donates, instead of accepting, electrons.

127. Moreover, lithium atoms and cations do not have d-orbitals; and unlike the highly electron withdrawing trifluoroacetate moiety, the hydroxyquinolato anion is considered electron donating. Additionally, unlike hexamethylbenzene with six electron donating methyl groups that increase the electron density of the pi-system, BPhen's "planar central structure," or the phenanthroline ring, is substituted with phenyl rings which are considered to be slightly electron withdrawing. As a result, the coordination environment for Liq

and BPhen is completely different than that for $\text{Rh}_2(\text{O}_2\text{CF}_3)_4$ and hexamethylbenzene.

128. Furthermore, the reaction condition deployed by Cotton for forming the complex of the arene adducts of $\text{Rh}_2(\text{O}_2\text{CF}_3)_4$ differs greatly from that reported by Ma. According to Cotton, the arene adduct was formed over 2 weeks, indicating that the reaction is likely a slow one producing a thermodynamic mixture. (EX1012 (see synthesis of the dirhodium adduct)). In contrast, the thermal evaporation and deposition of Liq and BPhen in Ma took place on the order of 1,000 seconds (or about 17 minutes). Ma, 811 (deposition rate for organic materials is $\sim 0.5 \text{ \AA/s}$, thus it would take about $50 \text{ nm} / 0.5 \text{ \AA/s} = 1000$ seconds to deposit a 50 nm layer Liq-doped ETL). A person of ordinary skill in the art would view the thermal evaporation process as likely yielding kinetic products because of the short reaction span.

129. Samsung then points to the '223 patent's teaching that BPhen "can ... form chain-like structures when coordinated to certain metal complexes." Pet. 66. But that statement does not say and a person of ordinary skill in the art would not interpret this statement as saying that BPhen would form a chain-like structure with every metal complex, including with the lithium center under Ma's reaction conditions. Indeed, when BPhen coordinates to a metal center, BPhen coordinates in a bidentate fashion to a single metal center given the rigid ring structure, as I

have discussed above. While it is possible that a metal center may interact with the phenyl or phenanthroline's pi-electrons, Samsung has not presented any evidence that this mode of interaction exists between the lithium cation of Liq and BPhen.

130. The literature thus supports the 223 patent's teaching that two heteroaromatic rings in a single organic ligand facilitate coordination of the ligand to different metal centers to form a chain-like or network-like structure. *See* EX1001, 3:53-67 ("Preferably, the organic compound comprises more than one heteroaromatic compound. This enables the organic compound to coordinate to several metal complexes simultaneously. In contrast to an aromatic compound, a heteroaromatic compound has the advantage that it is not only able to coordinate to a metal complex via the aromatic system (π -electrons), as described in the publication by Cotton in *Organometallics* which is cited above, but furthermore the coordination can also be effected directly via the heteroatom. The greater the number of heteroaromatic compounds in the organic compound, the greater the number of possible coordination sites for a metal complex. Here, N is a preferred heteroatom. Due to the mostly free electron pair, N has very good coordination properties with respect to metal complexes.").

131. But the literature does not support Samsung's theory that the two nitrogen atoms on the same phenanthroline ring or a combination of a nitrogen atom and an aromatic ring would be expected to bridge two different single-

nuclear metal centers such as to the lithium centers of Liq. I am not aware of any such compounds had been reported by 2008/2009.

132. I also note that the '223 patent does not teach that BPhen would always form a chain-like or network-like structure with any metal complex. Instead, the '223 patent teaches the type of structures that may lead to the claimed structures; and a POSITA would understand the combination that would lead to the claimed structures. For instance, the '223 patent teaches that “[t]he presence of more than one central atom improves the possibility that several organic compounds will coordinate simultaneously to the metal complex.” EX1001, 2:42-44; *see also* EX1001, 2:49-58 (discussing Cottons’ dirhodium complex and its adduct with an aromatic in the context of discussing why “[m]etal complexes having two central atoms are particularly well suited for the formation of chains”). In contrast, Samsung does not argue in this proceeding that Liq has more than one central atom. Thus, it has not explained why the state of the art would have suggested to a person of ordinary skill in the art that doping Liq in BPhen would form a chain-like or network-like structure given BPhen’s tendency to coordinate to a single metal center at a time (if coordinated at all).

D. Ma in light of Shtein Does Not Disclose or Suggest Using OVPD to Obtain a More Uniform Film of Liq and BPhen

133. I understand that Samsung asserts that a person of ordinary skill in the art would have modified parameters of deposition to achieve coordination of BPhen and Liq in gas phase. Pet. 70. Samsung argues that “a deposited layer of coordinated BPhen and Liq will contain a more uniform distribution of BPhen and Liq, than if the BPhen and Liq are individually deposited” *Id.* Samsung asserts that a person of ordinary skill in the art would be motivated to obtain a deposited layer with more uniform distribution of BPhen and Liq allegedly because “[a] POSA would have understood that a more uniform layer of coordinated BPhen and Liq would allow for the more efficient transfer of electrons through that layer.” *Id.*

134. To the extent coordination of BPhen to Liq is possible and coordination increases the uniformity of the film and hence performance as Samsung states, that benefit can also be achieved if the coordination occurs when BPhen and Liq reacts on the deposition surface. See EX1001, 11:20-24 (“the joint vaporization of the metal complex with the organic compound in the gas phase *or on the deposited surface results in interactions*, so that the compounds coordinate to each other”). Since the deposited films are built molecular layer by molecular layer, the coordination (if any) would not just occur at the top surface as Samsung

seems to assume, but would occur as each molecular layer as the molecules are deposited, therefore forming a uniform film. Samsung therefore has made a wrong assumption about what happens in thermal deposition.

135. Additionally, I have not seen any evidence in the record that a person of ordinary skill in the art would have known the conditions under which a substantial amount of BPhen would react with Liq in order to produce a more uniform distribution of BPhen and Liq. Pet. 70. A person of ordinary skill in the art would not have expected OVPD to achieve that goal or to promote coordination of BPhen to Liq.

136. This is because the Shtein paper does not demonstrate that the method could have worked with a mixture of compounds, especially if they had substantially different vaporization or sublimation temperatures/enthalpies. Instead, Shtein only performed the experiment with a single compound Alq3, instead of a mixture. EX1008 at Experiment.

137. Moreover, in OVPD, “a hot, nonreactive carrier gas is used to transport an organic vapor toward a cooled substrate onto which the organic materials condense.” EX1008 at 4006. There is no evidence that OVPD could lead to a uniform film of Liq and BPhen or even that the condition would induce coordination of BPhen to Liq in the gas phase. For instance, there is no explanation why the presence of large amounts of inert gas molecules would not

interfere with the chance that a Liq moiety would collide with BPhen to form coordination. No analysis was done on what the net effect of the complicated and unpredictable thermodynamics and kinetics would be.

138. Indeed, given the complexity of thermodynamics and kinetics, a person of ordinary skill in the art would not have reasonably expected that OVPD would have promoted coordination of Liq with BPhen and resulted in a more uniform film of Liq and BPhen.

E. Ma Does Not Disclose or Suggest Cross-Linking

139. I have also been asked to comment on whether Ma's teaching of an optimal ratio of Liq and BPhen for best electron conductivity would have motivated a person of ordinary skill in the art to adjust the cross-linking density or that they would have understood that the degree of cross-linking density would affect electron conductivity.

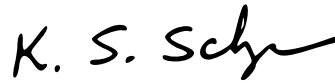
140. It is my opinion that they would not.

141. First, there is no evidence that a person of ordinary skill in the art would have even viewed the mixture of Liq and BPhen as forming a cross-linked structure, let alone that they would be motivated to control the degree of cross-linking density. Nor is there any evidence that a person of ordinary skill in the art would have understood that the ratio of Liq and BPhen would have led to different degrees of cross-linking.

142. Second, the only teaching that Samsung cites to support its argument that the degree of cross-linking is related to the electron conductivity comes from the '223 patent. Pet. 73-74. I understand that it is not proper to use the inventors' own insight against them in arguing obviousness because an inventor's path to invention is not evidence of obviousness.

I 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 Section 1001 of Title 18 of the United States Code.

Executed on October 28, 2024, in San Antonio, Texas.

A handwritten signature in black ink, appearing to read "K. S. Schanze", written over a horizontal line.

Kirk S. Schanze, Ph.D.

APPENDIX A

CURRICULUM VITAE

KIRK S. SCHANZE

PERSONAL

Title: Robert A. Welch Distinguished University Chair

Address: Department of Chemistry
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San Antonio, TX

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web: <http://www.utsa.edu/SchanzeLab>

EDUCATION

1979	B.S.	Florida State University B.S. (Chemistry)
1983	Ph.D.	University of North Carolina, Chapel Hill (Organic Chemistry)

PROFESSIONAL EXPERIENCE

2016 -	Robert A. Welch Distinguished University Chair, University of Texas, San Antonio
2014 - 2016	University Distinguished Professor, University of Florida
2013 - 2016	Prominski Professor of Chemistry, University of Florida
2012 - 2013	V.T. and Louise Jackson Professor of Chemistry, Univ. of Florida
1997 - 2012	Chairman, Organic Chemistry Division, University of Florida
1997 -	Professor, Department of Chemistry, University of Florida,
1992 - 1997	Associate Professor, Department of Chemistry, University of Florida
1986 - 1992	Assistant Professor, Department of Chemistry, University of Florida
1984 - 1986	Miller Postdoctoral Fellow, Chemistry Department, University of California, Berkeley.
1983 - 1984	Postdoctoral Research Associate, Department of Chemistry, University of North Carolina, Chapel Hill
1979 - 1983	Research Assistant, Department of Chemistry, University of North Carolina, Chapel Hill
1977 - 1979	Undergraduate Research Assistant, Department of Chemistry, Florida State University

HONORS AND AWARDS

2022	Organic Synthesis Distinguished Lectureship, New Jersey Institute of Technology
2021	Covestro Lectureship Award, University of Akron
2018	ACS Publications, Globalization Award
2015	Chinese Academy Presidents Fellowship, Institute of Chemistry, CAS, Beijing
2015	XingDa Lectureship, Peking University
2012	Inter-American Photochemical Society Award
2011	Fellow, American Chemical Society
2011	Visiting Professor, Tokyo Metropolitan University
2011	Japan Society for Promotion of Science Fellowship
2011 - 2012	Visiting Professor, Harbin Institute of Technology, Harbin, China
2009	Florida Award, American Chemical Society, Florida Section
2008	Honda-Fujishima Lectureship Award, Japanese Photochemical Association
2008	Visiting Professorship, ENS Cachan, Cachan, France
2008	Special Creativity Extension Award, National Science Foundation

2007 Visting Lecturer, Chemical Research Promotion Center, Taiwan
2006 - 2009 University of Florida Research Foundation Professorship
2005 UF SPP for Professors
2003 Peterson Award, Society for Experimental Mechanics (Best Paper 2002-2003)
2001 Gibson Term Professorship, University of Florida
1997 NASA Group Achievement Award, NASA Langley Research Center
1993 Teaching Incentive Award, CLAS, University of Florida
1984 - 1986 Miller Postdoctoral Fellowship, Miller Institute, UC Berkeley
1982 - 1983 Graduate School Fellowship, University of North Carolina, Chapel Hill
1980 - 1981 Dobbins Fellowship, Chemistry Department, University of North Carolina
1979 Faculty Fund Award, Florida State University
1979 Phi Beta Kappa Distinguished Student Award
1979 Phi Beta Kappa, Florida State University
1977 Phi Eta Sigma, Florida State University
1976 Phi Kappa Phi, Florida State University

PROFESSIONAL SOCIETIES

1983 - American Chemical Society
1987 - Inter-American Photochemical Society
2000 - Materials Research Society

Professional Service

2018 Co-Organizer, SUSTec-ACS Publications Workshop on Materials, Shenzhen, China
2016 Chair, ACS Publications Editors Conference, San Diego, CA
2015 Organizer, Workshop on Nanomaterials for Energy and Biotechnology, Harbin Institute of Technology
2015 ACS Publications, Chair Editor Search Committee
2014 ACS Publications, Chair Editor Search Committee
2012 Organizer, Symposium on Photonic Assemblies, Materials, and Catalysts for Solar Fuels, Southeast Regional ACS Meeting, Raleigh, NC
2010 Search Committee Member, Editor-in-Chief of ACS journal *Organometallics*
2010 External Reviewer, Department of Chemistry, University of Colorado
2010 Co-organizer, NSF Workshop on Inorganic Chemistry
2008 – 2009 President, Inter-American Photochemical Society (Elected by membership)
2007 Co-organizer, Symposium on Hybrid Functional Materials for Optical Applications, Materials Research Society Spring National Meeting, San Francisco, CA.
2006 – 2008 Vice-President, Inter-American Photochemical Society (Elected by membership)
2005 Co-chairman, Gordon Conference on Photochemistry, Bryant University, Smithfield, RI
2005 Panel Member and Report Writer, Workshop on Solar Energy Conversion, Department of Energy, Washington, DC, April 2005.
2004 - 2005 Member Scientific Advisory Board, QTL Biosystems, LLC, Santa Fe, NM
2004 - Panel Member, National Academy of Sciences, National Research Council Associateship Program
2000 - 2001 Organizer, Symposium on Inorganic Chemistry into the New Millenium, sponsored by Los Alamos National Laboratory, to be held in Santa Fe, NM, May 2001.
2000 - US Representative, Organizing Committee, International Union of Pure and Applied Chemistry (IUPAC) Conference on Photochemistry, to be held in Budapest, Hungary, 2001.

- 2000 - 2001 Member, Advisory Board, NIH Center for Fluorescence Spectroscopy, University of Maryland Medical School, Baltimore, MC
- 2000 Co-Organizer, Symposium on Strategy for Molecular and Supramolecular Photochemistry, International Chemical Congress of Pacific Basin Societies, "Pacifichem 2000", Honolulu, HI, Dec. 2000.
- 2000 Panel Reviewer, National Science Foundation CAREER Awards, Chemistry Division, Inorganic, Bioinorganic and Organometallic Program.
- 1999 Panel Reviewer, National Renewable Energy Laboratory (NREL), Department of Energy Basic Energy Sciences, September, 1998.
- 1999 Co-Organizer, US-Japan Symposium on Photosynthesis and Photoconversion, Institute for Molecular Sciences, Okazaki, Japan.
- 1998 Participant, Workshop for Complex Adaptive Materials, Los Alamos National Laboratory.
- 1997 Panel Reviewer, EPSCoR grant program, Department of Energy, Basic Energy Sciences.
- 1997 Co-Editor, Symposium-in-print edition of Journal of Chemical Education, "Applications of Inorganic Photochemistry to Biology, Chemical Analysis and Advanced Materials", published June, 1997.
- 1996 Co-Organizer, Symposium on Applications of Inorganic Photochemistry to Biology, Chemical Analysis and Advanced Materials, Division of Chemical Education, ACS National Meeting, Orlando, FL.
- 1996 Panel Reviewer, Argonne National Laboratory, Department of Energy Basic Energy Sciences.
- 1994 – 1996 Advisory Board, Inter-American Photochemical Society.
- 1995 Organizer, Symposium on Metal Complex Probes for DNA, American Society for Photobiology National Meeting.
- 1994 Panel Reviewer, NSF Center for Photoinduced Charge Transfer, University of Rochester, Rochester, NY.
- 1993 Co-Organizer, 6th Annual Winter Conference of the Inter-American Photochemical Society.
- 1993 Panel Reviewer, Presidential Postdoctoral Program Fellowships, Department of Energy, Basic Energy Sciences.
- 1988 Panel Reviewer, Solar Photochemistry Program, Department of Energy, Basic Energy Sciences.

EDITORIAL ACTIVITIES AND JOURNAL ADVISORY BOARDS

- 2024 - Deputy Editor, *ACS Central Science*. 2022 IF = 18.
- 2008 - 2023 Founding Editor-in-Chief, *ACS Applied Materials & Interfaces*, published 6230 papers in 2021, IF 10.38. Link: <http://www.acsami.org>. ACS AMI is ranked #46 in global publications (https://scholar.google.com/citations?view_op=top_venues)
- 2018 - 2023 Founding Editor-in-Chief, *ACS Applied Electronic Materials*, published 618 papers in 2021, IF 4.49, Link: <http://www.acsapm.org/>.
- 2018 - 2023 Founding Editor-in-Chief, *ACS Applied Polymer Materials*, published 695 papers in 2021, IF 4.85, Link: <http://www.acsaelm.org/>
- 2018 - 2023 Founding Editor-in-Chief, *ACS Applied Bio Materials*, published 778 papers in 2021, Link: <http://www.acsabm.org/>.
- 2018 - 2023 Founding Editor-in-Chief, *ACS Applied Energy Materials*, published 1624 papers in 2021, IF 6.96, Link: <http://www.acsaem.org/>.
- 2018 - 2023 Founding Editor-in-Chief, *ACS Applied Nano Materials*, published 1485 papers in 2021, IF 6.14, Link: <http://www.acsanm.org/>.
- 2022 - 2023 Founding Editor-in-Chief, *ACS Applied Engineering Materials*, Link: <https://pubs.acs.org/journal/aaemdr>

- 2022 - 2023 Founding Editor-in-Chief, *ACS Applied Optical Materials*,
Link: <https://pubs.acs.org/journal/aaoma6>
- 2021 - Editorial Advisory Board, *Journal of the Chinese Chemical Society*, Link:
<http://www.jccs.wiley-vch.de>
- 2008 – 2010 Editorial Advisory Board, *Langmuir*
- 1999 - 2008 Senior Editor, *Langmuir*, (American Chemical Society Journal of Colloid and Interfacial Science).
- 1996 - 2006 Co-Editor, *Molecular and Supramolecular Photochemistry*, 16 Edited Volumes Published by Marcel Dekker.
- 2000 - Editorial Advisory Board, *Journal of Photochemistry and Photobiology, Part C, Photochemistry Reviews*.
- 1994 - 1998 Editor, I-APS Newsletter, Feb. 1994 – May 1998.

RESEARCH INTERESTS

Chemistry of photoresponsive organic and polymer materials; electron and energy transfer processes; photophysics and photochemistry; applications of photochemistry; electrochemistry of thin films; conjugated polymers; polymeric coatings for luminescence imaging; organic electronics; solar cells.

SUMMARY OF TEACHING ACCOMPLISHMENTS AND OBJECTIVES

Courses Taught During Past 10 Years

Sp-21	General Organic Chemistry CHE 2603) / Sync-Async On-Line Course
F-20	Polymer Chemistry (CHM 4953/6937) / Sync-Async On-Line Course
Sp-20	General Organic Chemistry (CHE 3643) / In person – Async online
F-19	Polymer Chemistry (CHM 4953/6973)
Sp-19	Molecular and Materials Photochemistry (CHM 4953/6973)
F-18	Polymer Chemistry (CHM 4953/6937)
S-18	General Organic Chemistry (CHM 2603)
F-17	Polymer Chemistry (CHM 4953/6973)
Sp-15	General Organic Chemistry (CHM 2211) - UFL
Sp-14	Polymer Physical Chemistry (CHM 5511) - UFL
Sp-13	Physical Organic Chemistry (CHM 6225) - UFL
F-12	General Organic Chemistry (CHM 2210) - UFL
Sp-12	Physical Organic Chemistry (CHM 6225) - UFL
F-11	General Organic Chemistry (CHM 2210) - UFL
Sp-12	Physical Organic Chemistry (CHM 6225) - UFL

Teaching Objectives

- To teach students how to "teach themselves" college level course material. This objective is based on the idea that if we teach students how to learn, they will continue to learn long after leaving the University.
- Stress the use of problem solving in learning science/mathematical concepts.
- Help students develop self-confidence.
- Provide students with career counseling and advisement when necessary.
- Be available.

Service for the Department, College and University (Highlights)

Department

2022-2023 Co-Chair, Faculty Search Committee for 2 Faculty lines in Electrochemistry/UTSA
2022- Chairman, Departmental Faculty Review Advisory Committee/UTSA
2021- 2023 Chairman, Seminar Committee, Chemistry/UTSA
2020- 2022 Chairman, Technical Facilities Committee, Chemistry/UTSA
2019- 2020 Member, Chair Search Committee, Chemistry/UTSA
2017 - Member, Department Executive Committee/UTSA
2017- 2018 Chairman, Department Awards Committee/UTSA
2012 - Chairman, Committee for Faculty Hiring
2008 - 2012 Member, Committee for Faculty Hiring
2007- Chairman, Ad-Hoc Committee for EPA-RCRA Compliance
2001 - 2004 Chairman, Graduate Curriculum Committee, Chemistry Department
1997 - Chairman, Organic Chemistry Division (supervise Program Assistant)
1995 - 2007 Supervisor, Department Glass Shop (supervise one USPS employee)
1995 – 1997 Chairman, Technical Facilities Committee
1993 – 1995 Chairman, Department Safety Committee

College

2017 - 2020 College Faculty Review Advisory Committee/UTSA
2002 CLAS Term Professor Selections Committee
1999 CLAS PEP Selections Committee
1997 – 1999 CLAS Nominating Committee
1995 – 1997 Phi Beta Kappa Selections Committee

University

2022- Member, Faculty Senate/UTSA
2019-2020 Member, Search Committee for 2 Faculty members – ChemEng/UTSA
2019-2019 Member, Faculty Search Committee in Chemical Engineering/UTSA
2007 – 2009 Senator in University of Florida Faculty Senate
2002-2003 Provost's Task Force on Graduate Tuition Remission

Invited Research Seminars and Lectures

2023

Invited Symposium Lecture, CME NASA STEM Symposium, ACS National Meeting, San Francisco, CA, August 2023, *Luminescent Coatings for Aerodynamic Applications*

ACS Webinar on Artificial Intelligence for Learning, Teaching and Writing, Virtual Format, August 2023.

Keynote Lecture, 31st International Conference on Photochemistry, Sapporo, Japan, July 2023, *Photophysics and Electron Transfer Reactivity of Organic Ion Radicals*

15th International Symposium on Functional pi-Electron Systems, Raleigh, NC, June 2023, *Optical Control of Charge and Energy Transfer in Molecular Wires*

AFOSR Annual Materials Chemistry Program Review, Dayton, OH, June 2023, *Optical Control of Charge and Energy Transfer in Molecular Wires*

Symposium on New Directions in the Physical Chemistry of Organic Semiconductors”, ACS National Meeting, Indianapolis, IN, March 2023, *Optical Control of Charge and Energy Transfer in Molecular Wires*

2022

Universität Hamburg, Virtual Seminar, Dec. 2022, *Conjugated Polyelectrolytes: Properties and Applications*

University of Massachusetts, Lowell, Department of Chemistry, Dec. 2022, *Conjugated Polyelectrolytes: Properties and Applications*

Rice University, Department of Chemistry, Nov. 2022, *Conjugated Polyelectrolytes: Properties and Applications*

Invited Lecture, Symposium on Supramolecular and Organic Materials, Southwest Regional ACS Meeting, Baton Rouge, LA, Nov. 7, 2022, *Nanostructure Conjugated Polyelectrolytes. Properties and Applications*

Invited Symposium Lecture, Makhilous Haddadin Symposium, American University of Beirut, Beirut, Lebanon, Oct. 6 – 7, 2022, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

Keynote Lecture, PMSE Young Investigator Symposium, ACS Fall National Meeting, Chicago, IL, Aug. 2022, *A Retrospective to Career Building: Opportunistic Research in Applied Polymer Science*

AFOSR Annual Materials Chemistry Program Review, Dayton, OH, June 2022, *Optical Control of Charge and Energy Transfer in Molecular Wires*

ACS Meeting in Miniature, Dallas, TX, April 2022, *Chromophore-Catalyst Assemblies for Solar Fuels*

University of Texas at Dallas, Department of Chemistry, April 2022, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

Symposium for 100th Anniversary of Michael Kasha, ACS Spring National Meeting, San Diego, CA, April 2022, *Conjugated Organometallic Chromophores and Polymers: Properties and Applications*

Organic Synthesis Distinguished Lectureship, New Jersey Institute of Technology, Department of Chemistry, Feb. 2022, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

Virtual Seminar, IMRE Singapore, Feb. 2022, *Introduction to ACS Applied Materials & Interfaces*

University of Texas at San Antonio, Department of Chemistry, Feb. 2022, *Public Access to Scientific Literature: The (Long) Road to Open Science*

Washington University, Department of Chemical Engineering, St. Louis, MO, Feb. 2022, *Conjugated Polyelectrolytes Properties and Applications*

Virtual Seminar, University of Richmond, Department of Chemistry, Jan. 2022, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

2021

University of Washington, Department of Chemistry, Dec. 2021, *Conjugated Polyelectrolytes: Properties and Applications*

Hope College, Department of Chemistry, Nov. 2021, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

School of Polymer Science and Polymer Engineering, University of Akron, Covestro Lectures, Nov. 2021, *Chromophore-Catalyst Assemblies for Solar Fuels*

School of Polymer Science and Polymer Engineering, University of Akron, Covestro Lectures, Nov. 2021, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

Virtual: Symposium on Frontiers in Conjugated Polymer Design and Synthesis, ACS Spring National Meeting, April 2021, *Water soluble poly(Phenylene Ethynylene)s for Bio Applications*

2020

Virtual: Materials Chemistry Frontiers Webinar in Honor of Fred Wudl, Dec. 2020, *A Brief History of Conjugated Polyelectrolytes – In Honor of Prof. Wudl*

University of Texas at San Antonio, Department of Chemistry, Oct. 2020, *Adventures with Water Soluble Conjugated Polymers*

University of California at San Diego, Department of NanoEngineering, La Jolla, CA, Feb. 2020, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

Texas State University, Department of Chemistry and Biochemistry, San Marcos, TX, Jan. 2020, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

2019

ACS Publications Symposium. Innovation In Materials Science and Technology, Nanyang Technological University, Singapore, Nov. 2019, *Chromophore-Catalyst Assemblies for Solar Fuels*

Macro Symposium, University of Michigan, Ann Arbor, MI, Oct. 2019, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

Plenary Lecture, 18th Asian Conference on Colloid and Interface Science (ACCIS), Kathmandu, Nepal, Sept. 2019, *Nanostructured Conjugated Polyelectrolyte Films. Properties and Applications*

2019 Research and Applications of Photonics in Defense Conference (RAPID), Miramar, FL, Aug. 2019, *Organometallic Non-Linear Chromophores*

Polymers for Advanced Technology-2019, Texas A&M University, College Station, TX, Aug. 2019, *Chromophore-Catalyst Assemblies for Solar Fuels*

Institute for Process Engineering, Chinese Academy of Sciences, June 2019, *Chromophore-Catalyst Assemblies for Solar Fuels*

Institute of Chemistry, Chinese Academy of Sciences, June 2019, *Chromophore-Catalyst Assemblies for Solar Fuels*

Nanyang Technological University, School of Chemical and Biological Engineering, Singapore, June 2019, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

ICMAT 2019 Conference, Nanomaterials for Biointerfacial Science, Singapore, June 2019, *Water Soluble Conjugated Polyelectrolytes*

South China University of Science and Technology, State Key Laboratory of Luminescent Materials and Devices, Guangzhou, China, June 2019, *Nanostructured Films of Conjugated Polyelectrolytes*

Sun Yat Sen University, School of Materials Science and Engineering, Guangzhou, China, June 2019, *Chromophore-Catalyst Assemblies for Solar Fuels*

Shanxi University, School of Environmental Science, Taiyuan, Shanxi, China, June 2019, *Chromophore-Catalyst Assemblies for Solar Fuels*

Keynote Invited Speaker, Fluorofest Conference, Texas Christian University, Ft. Worth, TX, May 2019, *Fluorescent Water-Soluble Conjugated Polymers: Fundamentals and Applications to Biosensing*

Shanghai Institute for Organic Chemistry (SIOC), Chinese Academy of Sciences, Shanghai, China, May 2019, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

International Symposium on Resource Chemistry, Shanghai Normal University, Shanghai, China, May 2019, *Photocatalysis Mechanisms and Polymer Chromophore-Catalyst Assemblies*

Florida Section American Chemical Society Meeting, Symposium in Honor of John R. Reynolds, Tarpon Springs, FL, May 2019, *Chromophore-Catalyst Assemblies for Solar Fuels*

Materials Research Conference, Symposium on Nanostructured Materials, Phoenix, Arizona, April 2019, *Chromophore-Catalyst Assemblies for Solar Fuels*

South China University of Science and Technology, School of Chemical Engineering, Guangzhou, China, Mar. 2019, *Chromophore-Catalyst Assemblies for Solar Fuels*

Keynote Lecture, The 3rd International Symposium on Translational Nanomedicine, Guangzhou, China, Mar. 2019, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

ACS National Meeting, Symposium on Antimicrobial Polymers, Orlando, FL, Mar. 2019, *Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection*

ACS National Meeting, Chemistry of Materials 30th Anniversary Symposium, Orlando, FL, Mar. 2019, *Conjugated Organometallic Chromophores and Polymers. Properties and Applications*

University of North Texas, Department of Chemistry, Denton, TX, Feb. 2019, *Conjugated Organometallic Chromophores and Polymers. Properties and Applications in Organic Electronics*

University of Texas at Austin, Department of Chemistry, Austin, TX, Feb. 2019, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

University of California at Santa Cruz, Department of Chemistry, Santa Cruz, CA, Feb. 2019, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

East China University of Science and Technology, Department of Chemistry, Shanghai, China, Jan. 201, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

Inter-American Photochemical Society Annual Meeting, Sarasota, FL, Jan. 2019, *Triplet States in Organometallic Conjugated Materials*

2018

Qilu Institute of Technology, Key Lab of Paper Science, Jinan, Shandong, China, Dec. 2018, *Chromophore-Catalyst Assemblies for Solar Fuels*

Chinese Academy of Sciences, Beijing China, Dec. 2018, *Chromophore-Catalyst Assemblies for Solar Fuels*

Texas Christian University, Department of Chemistry, Ft. Worth, TX, Nov. 2018, *Chromophore-Catalyst Assemblies for Solar Fuels*

UNAM, Department of Chemistry, Mexico City, Mexico, Sept. 2018, *Chromophore-Catalyst Assemblies for Solar Fuels*

Benemérita Universidad Autonoma de Puebla, Department of Chemistry, Puebla, Mexico, Sept. 2018, *Chromophore-Catalyst Assemblies for Solar Fuels*

ACS National Meeting, Symposium on Self-Assembled Polymers, Aug. 2018, *Self-Assembly of Conjugated Polyelectrolytes*

ACS National Meeting, Symposium on Supramolecular Sensing Materials, Aug. 2018, *Conjugated Polyelectrolytes as Supramolecular Sensing Materials*

Texas Soft Matter Meeting, Department of Chemical Engineering, University of Texas, Austin, Aug. 2018, *Conjugated Polyelectrolytes in Biosensing and Disinfection*

Anhui University, Department of Chemistry, Hefei, China, *Peer-Review: Why, How-To, and What Not To Do*

Hong Kong University of Science and Technology, Department of Chemical and Biological Engineering, Hong Kong, August 2018, *Chromophore-Catalyst Assemblies for Solar Fuels*

Department of Energy, Materials Chemistry Program Conference, Gaithersburg, MD, July 2018, *iClick Synthesis of Metallopolymers and Multimetallic Complexes*

Plenary Lecture, Polymer Processing Society Meeting, Taipei, Taiwan, May 2018, *Water Soluble Conjugated Polyelectrolytes: Structures, Properties, Processing and Applications*

Hong Kong University of Science and Technology, Department of Chemistry, Hong Kong, April 2018, *Water Soluble Conjugated Polyelectrolytes: Structures, Properties and Applications*

South China University of Technology, Guangzhou, China, April 2018, *Water Soluble Conjugated Polyelectrolytes: Structures, Properties and Applications*

Sun-Yat Sen University, Guangzhou, China, April 2018, *Chromophore-Catalyst Assemblies for Solar Fuels*

Workshop on Materials in Bio- and Nanotechnology, SUSTec, Shenzhen, China, April 2018,
Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection

Symposium on Molecules and Materials for Solar Fuels, ACS National Meeting, New Orleans,
LA, March 2018, *Chromophore-Catalyst Assemblies for Solar Fuels*

Keynote Lecture, MANA Conference, National Institute for Materials Science, Tsukuba, Japan,
March 2018, *Chromophore-Catalyst Assemblies for Solar Fuels*

Plenary Lecture, Molecules and Materials for Artificial Photosynthesis, Fusion Conference,
Cancun, Mexico, March 2018, *Chromophore-Catalyst Assemblies for Solar Fuels*,

IISER Mohali, Mohali, India, February 2018, *Molecular and Polymer Chromophore-Catalyst
Assemblies for Solar Fuels Production*

University of New Delhi, New Delhi, India, February 2018, *Molecular and Polymer
Chromophore-Catalyst Assemblies for Solar Fuels Production*

2017

Tulane University, New Orleans, LA, November 2017, *Molecular and Polymer Chromophore-
Catalyst Assemblies for Solar Fuels Production*

Nanjing Tech University, Nanjing, China, November 2017, *Chromophore-Catalyst Assemblies
for Solar Fuels*

Fudan University, Shanghai, China, November 2017, *Applications of Conjugated
Polyelectrolytes in Biosensing and Disinfection*

Plenary Lecture, Korean Chemical Society National Meeting, Gwangju, Korea, October 2017,
Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection

Yonsei University, Seoul, Korea, October 2017, *Applications of Conjugated Polyelectrolytes in
Biosensing and Disinfection*

Korea University, Seoul, Korea, October 2017, *Applications of Conjugated Polyelectrolytes in
Biosensing and Disinfection*

Ewha Womens University, Seoul, Korea, October 2017, *Light Harvesting Polymers for Energy
Conversion and Solar Fuels*

Daegu University, Daegu, Korea, October 2017, *Properties and Applications of Conjugated
Polyelectrolytes*

Shaanxi Normal University, Xi'an, China, September 2017, *How to Write an Effective Research
Paper*

Institute of Chemistry, Chinese Academy of Sciences, September 2017, Beijing, China,
Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection

Dalian University of Technology, Dalian, China, September 2017, *Triplet States in
Organometallic Conjugated Materials*

ACS Publications Symposium: Innovation in Energy Conversion, Dalian Institute of Chemical Physics, Dalian, China, September 2017, *Light Harvesting Polymers for Energy Conversion and Solar Fuels*

Plenary Lecture, Brazil Materials Research Conference, Gramado, Brazil, September 2017, *Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection*

Shanghai University of Electric Power, Shanghai, China, August 2017, *How to Write an Effective Research Paper*

ACS National Meeting, Symposium on Triplet Excited States, Washington, DC, August 2017, *Triplet States in Organometallic Conjugated Materials*

ACS National Meeting, Presidential Symposium, Washington, DC, August 2017, *Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection*

Department of Energy, Basic Energy Sciences, PIs Meeting, Washington, DC, July 2017, *Molecular and Polymer Chromophore-Catalyst Assemblies for Solar Fuels Production*

Plenary Lecture, Symposium on Applications of Coordination Compounds, University of St. Andrews, Scotland, July 2017, *Triplet States in Organometallic Conjugated Materials*

University of Science and Technology China, Hefei, China, *Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection*

Hefei University, Hefei, China, June 2017, *Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection*

Anhui University, Hefei, China, June 2017, *Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection*

Materials Research Conference, Symposium on Photoactive Nanoparticles and Nanostructures, Phoenix, Arizona, April 2017, *Nanostructured Conjugated Polyelectrolyte Films. Properties and Applications*

Materials Research Conference, Symposium on Development and Integration of Organic and Polymeric Materials for Thin-Film Electronic Devices Phoenix, Arizona, April 2017, *Light Harvesting Polymers for Energy Conversion and Solar Fuels*

Yee Fong Lecturer of Chemistry, National Taiwan University, Department of Chemistry, March 2017, *Light Harvesting Polymers for Energy Conversion and Solar Fuels*

2016

National University of Singapore, Department of Chemical Engineering, Singapore, December 2016, *Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection*

Nanyang Technological University, Department of Chemical Engineering, Singapore, December 2016, *Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection*

Shanghai University, Shanghai, China, December 2016 *Properties and Applications of Conjugated Polyelectrolytes*

KAUST Solar Research Conference, King Abdulla University of Science and Technology, Thuwal, Saudi Arabia, October 2016, *Chromophore Catalyst Assemblies for Solar Fuels*

College of Science Open House, UTSA Campus, San Antonio, TX, October 2016, *Water Soluble Conjugated Polyelectrolytes: Properties and Applications*

Sino-British Forum for Collaborative Partnership and Advanced Functional Materials, Sichuan University, Chengdu, China, September 2016, *Light Harvesting Polymers for Energy Conversion and Solar Fuels*

Hunan University, Department of Chemistry, Changsha, China, September 2016, *Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection*

Symposium on Light Manipulating Organic Materials and Devices III, SPIE Optics and Photonics Meeting, San Diego, CA, August 2016, *Ultrafast Photoinduced Charge Transfer in pi-Conjugated Electron Systems: Effects of Structure, Delocalization, and Energetics*

Symposium in Honor of Thomas J. Meyer, American Chemical Society National Meeting, Philadelphia, PA, August 2016, *Chromophore Catalyst Assemblies for Solar Fuels*

Electrochemical Energy Science and Technology (EEST2016), Plenary Lecture, August 2016, *Chromophore Catalyst Assemblies for Solar Fuels*

Nanjing Tech University, Nanjing, China, August 2016, *Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection*

Tongji University, Department of Chemical Engineering, Shanghai, China, August 2016, *Properties and Applications of Conjugated Polyelectrolytes*

South University of Science and Technology, Shenzhen, China, June 2016, *Properties and Applications of Conjugated Polyelectrolytes*

Tsinghua University, Graduate Campus Shenzhen, Shenzhen, China, June 2016, *Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection*

Technical Institute of Physics, Chinese Academy of Sciences, Beijing, China, June 2016, *Water Soluble Conjugated Polyelectrolytes: Properties and Applications*

Symposium in Honor of Jack Saltiel, Annual Meeting of the Society for Photobiology, Tampa, FL, May 2016, *Triplet States in Organometallic Materials*

Nanjing Normal University, Department of Chemistry, May 2016, *Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection*

Shanghai Normal University, Department of Resource Chemistry, May 2016, *Light Harvesting Polymers for Energy Conversion and Solar Fuels*

Tufts University, Department of Chemistry Seminar, April 2016, *Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection*

Symposium on Non-Linear Optical Chromophores and Materials, Materials Research Society Meeting, Phoenix, AZ, March 2016, *Triplets in Organic Photovoltaics*

Fusion Conference on Solar Fuels, Cancun, Mexico, February, 2016, *Light Harvesting Polymers for Energy Conversion and Solar Fuels*

2015

Symposium on Metal-containing π -Conjugated Systems: Syntheses, Properties, Applications, Pacificchem Conference, Honolulu, HI, December 2015, *Non-linear Organometallic Chromophores and Materials*

Keynote Speaker, Symposium on Conjugated Polymers for Biological Applications, Pacificchem Conference, Honolulu, HI, December, 2015, *Applications of Conjugated Polyelectrolytes in Biosensing and Disinfection*

Plenary Lecture, Workshop on Nanomaterials for Energy and Biotechnology, Harbin Institute of Technology, Harbin, China, November, *Materials and Interfaces for Solar Fuels*

Berkeley Laboratory, Berkeley, CA, September, *Triplet States in Organometallic Conjugated Materials*

Plenary Lecture, International Conference on Material Technology and Environmental Engineering, Shanghai, China, August, *Light Harvesting Polymers for Energy Conversion and Solar Fuels*

University of Science and Technology, Beijing, June, *Properties and Applications of Conjugated Polyelectrolytes*

Conference on Polymers for Advanced Technology, Hangzhou, China, June, *Conjugated Polyelectrolytes: Fundamentals and Application to Solar Cells*

Conference on Optical Probes of Conjugated Polymers, University of Science and Technology, Hong Kong, June, *Energy Transfer in Conjugated Polymers and Oligomers*

University of Hong Kong, Hong Kong, June, *Properties and Applications of Conjugated Polyelectrolytes*

Plenary Lecture, Brazilian Chemical Society Annual Meeting, São Paulo, Brazil, May *Water Soluble Conjugated Polyelectrolytes: Properties and Applications*

Hanyang University, Seoul, Korea, May, *Properties and Applications of Conjugated Polyelectrolytes*

Yonsei University, Seoul, Korea, May, *Properties and Applications of Conjugated Polyelectrolytes*

Ewha Womens University, Seoul, Korea, May, *Properties and Applications of Conjugated Polyelectrolytes*

Peking University, XingDa Lectureship, May, *Water Soluble Conjugated Polyelectrolytes: Properties and Applications*

University of Texas at San Antonio, April, *π -Conjugated Molecules and Polymers: Photonic Properties and Applications*

Argonne National Laboratory, Argonne, IL, April, *Properties and Applications of Conjugated Polyelectrolytes*

Nanjing Normal University, Department of Chemistry, Nanjing, China, April, *Properties and Applications of Conjugated Polyelectrolytes*

Nanjing University, Department of Polymer Chemistry, Nanjing, China, April, *Properties and Applications of Conjugated Polyelectrolytes*

ACS Applied Materials & Interfaces Workshop, Beijing, China, April *Properties and Applications of Conjugated Polyelectrolytes*

Southeast Ultrafast Conference, Florida State University, Tallahassee, FL, January, *Light Harvesting Polymers for Energy Conversion and Solar Fuels*

Purdue University, Department of Chemistry and Biochemistry, West Lafayette, IN, January, *Properties and Applications of Conjugated Polyelectrolytes*

2014

Florida State University, Department of Chemical and Biological Engineering, Tallahassee, FL, December, *Properties and Applications of Conjugated Polyelectrolytes*

First International Conference on Polymer Science and Engineering, Beijing University of Chemical Technology, Beijing, China, November, *Conjugated Polyelectrolytes: Fundamentals and Application to Solar Cells*

Air Force Office of Scientific Research Program Review, Washington, DC, October, *Non-Linear Organometallic Chromophores and Materials*

KAUST Workshop on Applied Materials Chemistry, King Abdullah University of Science and Technology, Thuwal, Saudi Arabia, October, *Nanostructured Films of Conjugated Polyelectrolytes*

Shanghai Institute of Physics, Shanghai, China, September, *Water Soluble Conjugated Polyelectrolytes: Properties and Applications*

International Symposium on Resource Chemistry, Shanghai Normal University, Shanghai, China, September, *Light Harvesting Polymers for Energy Conversion and Solar Fuels*

ACS National Meeting, Symposium on Publishing, San Francisco, CA, August, *Building BRICK by BRICK Sometimes Works: How ACS Editors' Participation in ACS on Campus Has Brought Publishing Best Practices to 1000's of Authors in BRICKS Countries*

ACS National Meeting, Symposium on Metal Containing and Metallo-Supramolecular Polymers and Materials, San Francisco, CA, August, *Light Harvesting Polymers for Energy Conversion and Solar Fuels*.

Shaanxi Normal University, Key Laboratory for Applied Surface and Colloid Chemistry, Xi'an, China, June, *Nanostructured Films of Conjugated Polyelectrolytes*

National Taiwan University, Department of Materials Science and Engineering, Taipei, Taiwan, June, *Properties and Applications of Conjugated Polyelectrolytes*

National Cheng Kung University, Department of Materials Science and Engineering, Tainan, Taiwan, June, *Properties and Applications of Conjugated Polyelectrolytes*

Academia Sinica, Chemistry Department, Taipei, Taiwan, June, *Properties and Applications of Conjugated Polyelectrolytes*

Electrochemical Society Meeting, Orlando, FL, May, *Properties and Applications of Conjugated Polyelectrolytes*

Colloquium Speaker, Naval Research Laboratory, Chemistry Division, Washington, DC, May
Water Soluble Conjugated Polyelectrolytes: Properties and Applications

ACS National Meeting, Symposium on Scientific Publishing, Dallas, TX, March, *Ethics in Scientific Publication*

ACS National Meeting, Symposium on Conjugated Polymers, Dallas, TX, March, *Interaction of Conjugated Polyelectrolytes with Proteins: Fundamentals and Application to Protein Sensing*

Heilongjiang University, Key Laboratory for Functional Inorganic Materials, Harbin, Heilongjiang, China, March *Light Harvesting Polymers for Energy Conversion and Solar Fuels and Conjugated Polyelectrolytes: Fundamentals and Application to Hybrid Solar Cells*

Harbin Institute of Technology, Department of Applied Chemistry, Harbin, Heilongjiang, China, March, *Light Harvesting Polymers for Energy Conversion and Solar Fuels*

University of Texas at Dallas, Department of Chemistry, Dallas, TX, February, *π -Conjugated Molecules and Polymers: Photonic Properties and Applications*

2013

NIIST-Thiruvandrum, Kerala, India, November, *Properties and Applications of Conjugated Polyelectrolytes*

Indian Institute of Science and Engineering Research - Thiruvandrum, Kerala, India, November, *Properties and Applications of Conjugated Polyelectrolytes*

Plenary Lecture, 5th Asian Conference on Colloid and Interface Science (ACCIS), Darjeeling, West Bengal, India, November, *Nanostructured Films of Conjugated Polyelectrolytes*

University of Houston, Department of Chemistry, Houston, TX, November, *π -Conjugated Molecules and Polymers: Photonic Properties and Applications*

Chemical Sciences Division, King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia, October, *Organometallic Conjugated Polymers and Oligomers: Carrier Transport and Solar Applications*

Department of Chemistry, Beijing Institute of Technology, Beijing, China, October 2013, *Conjugated Polyelectrolytes: Fundamentals and Application to Biosensors and Hybrid Solar Cells*

Department of Chemical and Biomolecular Engineering, National University of Singapore, Singapore, *Conjugated Polyelectrolytes: Fundamentals and Application to Biosensors and Light Activated Antimicrobials*

Asia America Chemical Symposium on “Advanced Materials”, 15th Asian Chemical Congress, Singapore, August, *Photonic Applications of Conjugated Polyelectrolytes*

15th IUPAC International Symposium on Macromolecular Complexes, Greenville, SC, August
Light Harvesting Polymers for Energy Conversion and Solar Fuels

Workshop on Charge Transfer on the Nanoscale, Brookhaven National Laboratory, Brookhaven, NY, May *Charge and Exciton Transfer on the Nanoscale in Light Harvesting Polymers*

Materials Research Society Meeting, Symposium QQ: Conjugated Polymers in Sensing and Biomedical Applications, San Francisco, CA, April *Light- and Dark-Activated Biocidal Activity of Cationic Conjugated Polyelectrolytes*

Materials Research Society Meeting, Symposium HH: Materials for High Performance Photonics, San Francisco, CA, April *Non-Linear Organometallic Chromophores and Materials*

Department of Chemistry, University of Miami, Coral Gables, FL, March, *Conjugated Molecules and Polymers: Photonic Properties and Applications*

Chemical Sciences Division, King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia, March, *Properties and Applications of Conjugated Polyelectrolytes*

Department of Chemistry, University of North Texas, Denton, TX, February, *Properties and Applications of Conjugated Polyelectrolytes*

Department of Chemistry, Ohio State University, Columbus, OH, February, *Organometallic Conjugated Polymers and Oligomers: Carrier Transport and Solar Applications*

Department of Chemistry, University of North Carolina, Chapel Hill, NC, January, *Conjugated Molecules and Polymers: Photonic Properties and Applications*

I-APS Award Lecture, Inter-American Photochemical Society Meeting, Sarasota, FL, January, *Properties and Applications of Conjugated Polyelectrolytes*

2012

University of São Paulo Conference on Nanotechnology, São Carlos, SP, Brazil, December, *Nanostructured Films of Conjugated Polyelectrolytes*

School of Chemistry and Biochemistry, Georgia Institute of Technology, Atlanta, GA, November, *Properties and Applications of Conjugated Polyelectrolytes*

AVS 59th International Symposium & Exhibition, Tampa, FL, October, *Light and Dark Activated Biocidal Activity of Conjugated Polyelectrolytes*.

Indian Association for the Advancement of Science, Kolkata, India, October, *Properties and Applications of Conjugated Polyelectrolytes*

Chemistry Division, Indian Institute of Science, Bangalore, India, October, *Properties and Applications of Conjugated Polyelectrolytes*

Indian Institute of Technology-Bombay, Department of Chemistry, Mumbai, India, October, *Properties and Applications of Conjugated Polyelectrolytes*

ACS Award in Polymer Science Symposium, ACS National Meeting, Philadelphia, PA, August, *Extreme Light Sources: A Long but not Strange Trip with Organic and Polymer Materials for Near-Infrared Emission*

Department of Chemistry, Jackson State University, Jackson, MI, June, *Properties and Applications of Conjugated Polyelectrolytes*

Institute of Chemistry, Chinese Academy of Sciences, Beijing, China, June, *Properties and Applications of Conjugated Polyelectrolytes*

Center for Functional Inorganic Materials, Heilongjiang University, Harbin, China, June, *Properties and Applications of Conjugated Polyelectrolytes*

PPG Research Center, Pittsburg, PA, April, *Properties and Applications of Conjugated Polyelectrolytes*

Department of Chemistry, University of Pittsburgh, April, *Pi-Conjugated Organometallic Oligomers and Polymers: From Molecular Wires to Organic Solar Cells*

Department of Chemistry and Biochemistry, Florida International University, Miami, FL, March *Properties and Applications of Conjugated Polyelectrolytes*

Symposium on Biocidal Materials and Interfaces, American Chemical Society National Meeting, San Diego, CA, March, *Light Activated Biocidal Activity of Conjugated Polyelectrolytes*

Department of Chemistry and Biochemistry, North Dakota State University, Fargo, ND, March, *Properties and Applications of Conjugated Polyelectrolytes*

Sanibel Conference, St. Simons Island, Georgia, February, *Triplet States in Organic Photovoltaics*

Department of Chemistry and Biochemistry, University of New Mexico, Albuquerque, NM, January, *Properties and Applications of Conjugated Polyelectrolytes*

2011

Symposium on Next Generation Solar Energy, University of Erlangen, Erlangen, Germany, December, *Triplet States in Organic and Organometallic Photovoltaics*

Symposium on Materials for High Performance Photonics, Materials Research Society, Fall National Meeting, Boston, MA, November, *Non-Linear Absorption in Organometallic Chromophores and Polymers*

F- π -10 International Symposium on Functional Pi-Electron Systems, Beijing, China, October, *Functional Organometallic π -Conjugated Electron Systems*

Department of Chemistry, Shandong University, Jinan, China, October, *Nanostructured Films of Conjugated Polyelectrolytes*

PSP Journal Bootcamp, Washington, DC, September, *How is Journal Content Created?*

Symposium on Metal-Containing and Metallo-Supramolecular Polymers and Materials, ACS National Meeting, Denver, CO, August, *Light Harvesting and Exciton Transport in Metal Complex Polymers*

Dynamic Multifunctional Materials for a Second Skin Concept Workshop, U.S. Army Natick Soldier RDE Center – Lord Community Center, Natick, Massachusetts, August, *Cationic Conjugated Polyelectrolytes as Versatile Biocidal Materials*

Annual Meeting, Solar Fuels Energy Frontier Research Center, University of North Carolina, Chapel Hill, NC, May, *Polymeric Chromophores for Light Harvesting, Energy Transport and Energy Conversion*

Industrial Chemistry Program, Tokyo University of Science, Tokyo, Japan, March, *Properties and Applications of Conjugated Polyelectrolytes*

Research Center for Solar Energy Chemistry, Osaka University, Toyonaka Campus, Osaka, Japan, February, *Properties and Applications of Conjugated Polyelectrolytes*

Institute of Scientific and Industrial Research (SANKEN), Osaka University, Suita Campus, Osaka, Japan, February, *Pi-Conjugated Organometallic Oligomers and Polymers: From Molecular Wires to Organic Solar Cells*

Department of Polymer Science, Kyoto University, Katsura Campus, Kyoto, Japan, February, *Properties and Applications of Conjugated Polyelectrolytes*

National Institute for Materials Science, Tsukuba, Japan, February, *Nanostructured Films of Conjugated Polyelectrolytes*

Chemical Resources Laboratory, Tokyo Institute of Technology, Suzukakedai Campus, Tokyo, Japan, February, *Pi-Conjugated Organometallic Oligomers and Polymers: From Molecular Wires to Organic Solar Cells*

Department of Chemistry, Tokyo Institute of Technology, Ookayama Campus, Tokyo, Japan, February, *Pi-Conjugated Organometallic Oligomers and Polymers: From Molecular Wires to Organic Solar Cells*

Department of Chemical and Nuclear Engineering, University of New Mexico, January, *Light Induced Processes in Chemistry and Engineering*

Department of Chemistry, Harbin Institute of Technology, Harbin, China, January, *Solar Energy Conversion*

Solar Energy Research Center Annual Conference, University of North Carolina, Chapel Hill, NC, January, *Polymeric Chromophores for Light Harvesting, Energy Transport and Energy Conversion*

2010

Department of Chemistry, Johns Hopkins University, Baltimore, MD, November, *Properties and Applications of Conjugated Polyelectrolytes*

Air Force Office of Scientific Research Polymer Program Review, Washington, DC, September, *Organometallic Chromophores and Materials for Non-Linear Absorption*

Department of Chemistry, University of Georgia, Athens, GA, September, *Properties and Applications of Conjugated Polyelectrolytes*

Department of Chemistry, Michigan State University, East Lansing, MI, September, *Properties*

and Applications of Conjugated Polyelectrolytes

Symposium in Honor of David Whitten, University of New Mexico, Albuquerque, NM, August, *Properties and Applications of Conjugated Polyelectrolytes*

Gordon Conference on Electron Donor-Acceptor Interactions, Salve Regina College, Newport, RI, August, *Triplet States in Organometallic Oligomers and Polymers*

IUPAC Symposium on Photochemistry, Ferrara, Italy, July, *Pi-Conjugated Oligomers and Polymers: From Molecular Wires to Organic Solar Cells*

Department of Energy, Solar Photochemistry Program Contractors Meeting, Annapolis, MD, June, *Conjugated Polymers and Polyelectrolytes in Solar Photoconversion*

F- π -9 International Symposium on Functional Pi-Electron Systems, Georgia Institute of Technology, Atlanta, GA, May, *Properties and Applications of Conjugated Polyelectrolytes*

Second Annual Meeting, EFRC for Solar Fuels, University of North Carolina, Chapel Hill, NC, May, *Polymers for Solar Energy Conversion*

American Chemical Society National Meeting, Symposium on Nanostructured Polymers, San Francisco, CA, March, *Nanostructured Films of Conjugated Polyelectrolytes*

2010 RIKEN Conference on Soft Materials and Interfaces, January, Harima, Japan, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Applications to Biosensors*

Mini-Symposium on Organometallics, Material Chemistry and Nanobiotechnology, RIKEN main campus, Wako, Japan, January, *Conjugated Polyelectrolytes: Applications to Biosensors and Light-Activated Biocides*

2009

Simon Fraser University, Department of Chemistry, Vancouver, British Columbia, Canada, September, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Applications to Biosensors*

University of British Columbia, Department of Chemistry, Vancouver, British Columbia, Canada, September, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Applications to Biosensors*

University of Victoria, Department of Chemistry, Victoria, British Columbia, Canada, September, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Applications to Biosensors*

Georgia Institute of Technology, Department of Polymer and Fiber Engineering, Atlanta, GA, September, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Applications to Biosensors*

NSF International Workshop on Nanomaterials and Functional Materials, UNICAMP, Campinas, Brazil, August, *Solar Energy Conversion*

Florida Award Lecture, Florida Section of the American Chemical Society Meeting, Orlando, FL, May, *Pushing Photons for Fun: Photochemistry from Small Molecules to Materials, Fundamentals to Applications*

Inorganic Chemistry Solar Energy Symposium, American Chemical Society National Meeting, Salt Lake City, UT, March, *Triplet States in Organometallic Photovoltaics*

Air Force Research Laboratory Workshop, Dayton, OH, March, *Linear and Non-Linear Optical Properties of Platinum-Acetylide Materials*

University of Central Florida, Department of Chemistry, Orlando, Florida, February, *Linear and Non-Linear Optical Properties of Platinum-Acetylide Materials*

American Chemical Society Editors Conference, San Diego, CA, January, *Introducing ACS Applied Materials & Interfaces*

2008

Materials Research Society Meeting, Boston, MA, November, *Energy Transport and Transduction in Conjugated Polyelectrolytes*

Fudan University, Department of Macromolecular Chemistry, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Applications to Biosensors*

Institute of Chemistry, Chinese Academy of Science, Beijing, China, October, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Applications to Biosensors*

Peking University, Department of Chemistry, Beijing, China, October, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Applications to Biosensors*

Langmuir Symposium, Tsinghua University, Department of Chemistry, Beijing, China, October, *Introducing ACS Applied Materials & Interfaces*

Honda-Fujishima Lecturship, Meeting of the Japanese Photochemical Association, Sakai City, Osaka, Japan, September, *Conjugated Polyelectrolytes: Amplified Quenching and Application to Biosensors*

Tokyo Metropolitan University, Department of Applied Chemistry, Tokyo, Japan, September, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Applications to Biosensors*

Symposium on Electroactive Polymers for Energy Conversion and Storage, American Chemical Society National Meeting, Philadelphia, PA, August, *Energy Transport and Conversion in Conjugated Polyelectrolytes*

SPIE Optics and Photonics National Meeting, Symposium on Organic Semiconductors in Sensors and Bioelectronics, San Diego, CA, August, *Conjugated Polyelectrolytes: Applications to Biosensors and Light-Activated Biocides*

Konarka Technologies, Lowell, MA, July, *Triplet States In Organometallic Photovoltaics*

University of North Carolina, Energy Frontier Research Center, Chapel Hill, NC, June, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Applications to Biosensors*

Ecole National Supérieure, Department of Chemistry, Cachan, France, June, *Optical Properties of Platinum Acetylide Oligomers and Polymers*

Department of Energy, Solar Photochemistry Program Contractors Meeting, Arlington, VA, June, *Conjugated Polyelectrolytes: Disrupted Interactions, Self-Assembled Structures and Hybrid Solar Photoconversion*

Air Force Office of Scientific Research Contractors Meeting, College Park, MD, May, *Second Generation Organometallic Materials for Non-Linear Absorption*

The Teaching Company, Chantilly, VA, April, *Powering the Planet: The Terawatt Challenge*

Organic Photovoltaics, Philadelphia, PA, April, *Triplet Excited States in Organic Photovoltaics*

Symposium on Novel Fluorophores -- Syntheses, Properties and Uses, American Chemical Society National Meeting, New Orleans, LA, April, *Applications of Conjugated Polyelectrolytes: Fluorescent Biosensors and Light Activated Biocides*

Symposium on Photochemistry and Photophysics of Inorganic Systems, American Chemical Society National Meeting, New Orleans, LA, April, *Exciton and Charge Transport in Organometallic Materials*

Center for Self-Assembled Chemical Structures Invited Lecturer, McGill University, Department of Chemistry, Montreal, Canada, February, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Application to Biosensors*

Center for Self-Assembled Chemical Structures Invited Lecturer, University of Montreal, Department of Chemistry, Montreal, Canada, February, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Application to Biosensors*

2007

Symposium on Metal-Containing and Metallo-Supramolecular Polymers and Materials, American Chemical Society National Meeting, Boston, MA, August, *Platinum-Acetylide Oligomers: Triplet Exciton and Negative Polaron Structure and Dynamics*

Symposium on Conjugated Polymer Materials and Hybrids: Synthesis, Macromolecular Assemblies, and Nanostructures, American Chemical Society National Meeting, Boston, MA, August, *Conjugated Polyelectrolytes: Synthesis, Macromolecular Assemblies and Nanostructures*

Gordon Research Conference on Photochemistry, Bryant University, Providence, RI, July, *Exciton and Charge Transport in Organometallic Molecular Wires*

National Taiwan University, Department of Chemistry, Taipei, Taiwan, June, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Application to Biosensors*

Academia Sinica, Institute of Chemistry, Taipei, Taiwan, June, *Optical Properties of Platinum Acetylide Oligomers*

National Tsing Hua University, Department of Chemistry, Hsinchu, Taiwan, June, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Application to Biosensors*

University of Denver, Department of Chemistry, Denver, CO, May, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Application to Biosensors*

National Renewable Energy Laboratory, Golden, CO, May, *Solar Energy Transport and Conversion Using Conjugated Polyelectrolytes*

Central Region American Chemical Society Meeting, Cincinnati, OH, May, *Optical Properties of Platinum Acetylide Oligomers*

Louisiana Technological University, Institute for Micromanufacturing, Ruston, LA, March, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Application to Biosensors*

University of Chicago, Department of Chemistry, Chicago, IL, February, *Optical Properties of Platinum Acetylide Oligomers and Polymers*

Symposium in Honor of V. Ramamurthy, University of Miami, Department of Chemistry, Coral Gables, FL, January, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Application to Biosensors*

Brookhaven National Laboratory, Department of Chemistry, Upton, NY, January, *Optical Properties of Platinum Acetylide Oligomers and Polymers*

2006

University of New Mexico, Department of Chemical Engineering, Albuquerque, NM, October, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Application to Biosensors*

Symposium on Chemical Utilization of Solar Energy, Southwest Regional American Chemical Society Meeting, Houston, TX, October, *Solar Energy Transport and Conversion Using Conjugated Polyelectrolytes*

SPiE Optics and Photonics National Meeting, San Diego, CA, August, *Second Generation Organometallic Materials for Non-Linear Absorption*

Los Alamos National Laboratory, Chemical Science and Technology Division, Los Alamos, NM, August, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Application to Biosensors*

Inter-American Photochemical Society Meeting, Salvador, Bahia, Brazil, June, Plenary Lecture *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Application to Biosensors*

NSF Workshop on Interplay of Experiment and Theory in Photochemistry, Salvador, Bahia, Brazil, June, *Optical Properties of Conjugated Organometallic Oligomers: Solutions, Aggregates and Gels*

Twenty-Eighth Department of Energy Solar Photochemistry Research Conference, Airlie Conference Center, Airlie, VA, June, *Nanoscale Assemblies of Conjugated Polyelectrolytes*

Seventh International Symposium on Functional π -Electron Systems, Osaka, Japan, May, Plenary Lecture, *Properties and Applications of Conjugated Polyelectrolytes*

Kyoto University, Department of Polymer Science, Kyoto, Japan, May, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Application to Biosensors*

Symposium on Nano-structured Polymers, American Chemical Society National Meeting, Atlanta, GA, March, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Application to Biosensors*

2005

Pacificchem 2005: Conference of the Pacific Basin Chemical Societies, Honolulu, HI, December, *Near-Infrared Polymer Light Emitting Diodes*

Pacificchem 2005: Conference of the Pacific Basin Chemical Societies, Honolulu, HI, December, *Optical Properties of Pi-Conjugated Organometallic Oligomers. Solutions, Aggregates and Gels*

University of South Carolina, Department of Chemistry, Columbia, SC, December, *Conjugated Polyelectrolytes: Self-Assembly and Applications to Energy Conversion and Biosensors*

University of Massachusetts, Department of Polymer Science and Engineering, Amherst, MA, September, *Conjugated Polyelectrolytes: Self-Assembly and Applications to Energy Conversion and Biosensors*

University of Rochester, Rochester, NY, Department of Chemical Engineering, September, *Conjugated Polyelectrolytes: Self-Assembly and Applications to Energy Conversion and Biosensors*

ACS Polymer Division, Symposium on Polymer Photonics, Orlando, FL, June, *Near Infrared Electroluminescence from Polymer / Lanthanide Complex Blends*

University of Michigan, Department of Materials Science and Engineering, Ann Arbor, MI, March, *Conjugated Polyelectrolytes: Self-Assembly and Applications to Energy Conversion and Biosensors*

2004

Symposium on Optical Properties of Organometallic Materials, Materials Research Society Fall Meeting, Boston, MA, November, *Linear- and Non-Linear Optical Properties of Platinum Acetylide Materials*

International Symposium on Functional Innovation of Molecular Informatics, Kyushu University, Fukuoka, Japan, October, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Biosensors*

Fifteenth International Symposium on the Photochemistry and Photophysics of Coordination Complexes, University of Hong Kong, Hong Kong, July, *Photophysics of Platinum Acetylide Oligomers and Polymers*

Sixth International Symposium on Functional π -Electron Systems, Cornell University, Ithaca, NY, June, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Biosensors*

Symposium on Organic Materials, Canadian Society for Chemistry National Meeting, London, Ontario, May, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Biosensors*

University of North Carolina, Department of Chemistry, Chapel Hill, NC, February, *Metal Complexes in Conjugated Electronic Systems: Fundamentals and Application to Near-Infrared Polymer Light Emitting Diodes*

University of Pittsburg, Department of Chemistry, Pittsburg, PA, February, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Biosensors*

2003

Symposium on Polymer Chemistry, Southeast Regional ACS Meeting, Atlanta, GA, November, *Near-Infrared Polymer Light Emitting Diodes*

Symposium on DNA and Electron Transfer, Southeast Regional ACS Meeting, Atlanta, GA, November, *Exciton Transport in Conjugated Polyelectrolytes*

University of Miami, Department of Chemistry, Coral Gables, FL, November, *Metal-Complexes in Conjugated Electronic Systems*

Bowling Green State University, Center for Photochemical Sciences, Bowling Green, OH, Plenary Lecture at Advisory Board Meeting, October, *Conjugated Polyelectrolytes: Self-Assembly, Amplified Quenching and Biosensors*

University of North Dakota, Department of Chemistry, Grand Forks, ND, October, *Exciton Transport in Conjugated Polyelectrolytes: Fundamentals and Application to Biosensors*

North Dakota State University, Department of Chemistry, Fargo, ND, October, *Exciton Transport in Conjugated Polyelectrolytes: Fundamentals and Application to Biosensors*

Emory University, Department of Chemistry, Atlanta, GA, September, *Exciton Transport in Conjugated Polymers: Fundamentals and Application to Near-IR Organic Light Emitting Diodes*

Emory University, Department of Chemistry, Atlanta, GA, September, *Light, Chemistry and Aerodynamic Engineering*

Workshop on Organometallic Materials, Air Force Research Laboratory, Dayton, OH, September, *Photophysics of Pt-Acetylides: Triplet Exciton Delocalization and Transport*

Carleton University, Department of Chemistry, Ottawa, Canada, September, *Luminescent Polymer Coatings for Pressure, Temperature and Strain Imaging*

Nagoya University, Department of Applied Chemistry, Nagoya, Japan, August, *Near-Infrared Organic Light Emitting Diodes*

Satellite Symposium on Photochemistry and Photobiology of Complexes, Ritsumeikan University, Kusatsu, Shiga, Japan, July, *Near-Infrared Organic Light Emitting Diodes*

International Conference on Photochemistry, Nara, Japan, July, *Photophysics of Pt-Acetylides: Triplet Exciton Delocalization and Transport*

National Science Foundation Workshop on Inorganic Chemistry, May, *Photophysics of Pt-Acetylides: Triplet Exciton Delocalization and Transport*

University of California at Los Angeles, Chemistry Department, May, *Singlet and Triplet Exciton Transport in Conjugated Polyelectrolytes*

University of Southern California, Chemistry Department, May, *Exciton Transport in Conjugated Materials: Fundamentals and Application to Near-IR Polymer Light Emitting Diodes*

Northwestern University, Department of Chemistry, Evanston, IL, May, *Exciton Transport in*

Conjugated Polyelectrolytes: Fundamentals and Application to Biosensors

Brookhaven National Laboratory Chemistry Department, Long Island, NY, March, *Exciton Transport in Conjugated Polyelectrolytes* Department of Chemistry, Aarhus

University, Aarhus, Denmark, January, *Fundamentals and Applications of Luminescence Imaging*

Inter-American Photochemical Society Meeting, Clearwater Beach, FL, January, *Exciton Transport in Conjugated Polyelectrolytes*

2002

Department of Chemistry, University of Arkansas, September, *Exciton Transport in Conjugated Polymers. Fundamentals and Applications to Near-IR Polymer Light Emitting Diodes*

National Research Council's Chemistry in the 21st Century: Symposium on Materials and Manufacturing, American Chemical Society National Meeting, August, *Applications of Luminescent Materials*

Symposium on Photo- and Chemiluminescence in Inorganic and Organometallic Systems, American Chemical Society National Meeting, August, *Luminescence in Platinum Acetylides*

Laboratoire de Chimie de Moleculaire, University of Strasbourg, Strasbourg, France, June, *Photophysics of Metal-Organic Conjugated Materials*

Department of Chemistry, Carnegie Mellon University, Pittsburg, PA, April, *Exciton Transport in Conjugated Polymers. Fundamentals and Applications to Near-IR Polymer Light Emitting Diodes*

Symposium on Chromogenic Phenomena in Polymers, American Chemical Society National Meeting, April, *Luminescent Polymer Coatings for Pressure, Temperature and Mechanical Strain Imaging*

Award Symposium for Thomas J. Meyer, American Chemical Society National Meeting, April, *Photophysics and Amplified Quenching in Metal-Organic Conjugated Polymers*

Brookhaven National Laboratory Chemistry Department, Long Island, NY, March, *Metal-Organic π -Conjugated Materials: Fundamentals and Application in Near-IR Electroluminescent Devices*

DOE Workshop on Charge Transfer at the Nanoscale, Santa Fe, NM, January, *Amplified Quenching in Organic and Metal-Organic Conjugated Materials*

2001

Air Force Research Laboratory, June, *Photophysics of Conjugated Polymers: Fundamentals and Applications to Sensing*

Symposium on Metals in Conjugated Materials, Materials Research Society National Meeting, San Francisco, CA, April, *Photophysics of π -Conjugated Metal-Organic Oligomers and Polymers*

QTL Biosystems, LLC, Santa Fe, NM, March, *Fluorescence Sensing with Cationic π -Conjugated Polyelectrolytes*

2000

Congress of the Pacific Basin Chemical Societies, Honolulu, HI, December, *Photophysics of π -Conjugated Metal-Organic Oligomers and Polymers*

27th Annual Meeting of the Federation of Analytical Chemistry and Spectroscopy Societies (FACSS), Nashville, TN, September, *Chemistry of Pressure and Temperature Sensitive Paints*

International Union of Pure and Applied Chemistry, Symposium on Photochemistry, Dresden, Germany, July, *Photophysics of π -Conjugated Metal-Organic Oligomers and Polymers*

Division of Electronic Materials, CEA-Grenoble, Grenoble, France, May, *Photolithographic Patterning of Electroactive Polymer Films and Electrochemically Modulated Diffraction Gratings*

Department of Chemistry, Loyola University, New Orleans, LA, January, *Chemistry of Luminescent Coatings for Imaging*

Department of Chemistry, Tulane University, New Orleans, LA, January, *Metal-to-Ligand Charge Transfer States: Fundamentals and Applications to Problems in Chemistry, Biological Chemistry and Aerospace Science*

1999

NSF Sponsored US-Japan Workshop on Supramolecular Photochemistry, New Orleans, LA, December, *Photophysics of π -Conjugated Metal-Organic Oligomers and Polymers*

NSF Sponsored US-Japan Workshop on Chemical Conversion and Photosynthesis, Okazaki, Japan, November, *Photophysics of π -Conjugated Metal-Organic Oligomers and Polymers*

Department of Chemistry, Florida State University, Tallahassee, FL, October, *Metal-to-Ligand Charge Transfer States: Fundamentals and Applications to Problems in Chemistry, Biological Chemistry and Aerospace Science*

Department of Chemistry, Syracuse University, Syracuse, NY, May, *Luminescence Imaging: Chemistry and Applications in Aerospace Science*

Department of Chemistry, SUNY Binghamton, Binghamton, NY, May, *Luminescence Imaging: Chemistry and Applications in Aerospace Science*

Reg Seiders Memorial Symposium, ACS National Meeting, Anaheim, CA, March, *Luminescence Imaging: Chemistry and Applications in Aerospace Science*

US-Japan Mini-Symposium, Laguna Beach, CA, March, *Photophysics of π -Conjugated Metal-Organic Oligomers and Polymers*

1998

Department of Chemistry and Center for Photochemical Sciences, Bowling Green State University, Bowling Green, OH, December, *Aerodynamic Applications of Inorganic Photophysics*

Department of Chemistry and Center for Photochemical Sciences, Bowling Green State University, Bowling Green, OH, December, *Photoinduced Electron and Energy Transfer in Metal-Organic Complexes*

Department of Chemistry, University of Washington, Seattle, WA, October, *Charge Transfer Excited States in Metal-Organic Complexes: From Radical Ions to DNA*

Symposium in honor of Professor Glenn Crosby, ACS National Meeting, Boston, MA, August, *The Temperature Dependence of MLCT Emission in Polypyridine-Ru(II) Complexes. Application to Cryogenic Wind-Tunnel Testing*

Symposium in Honor of Six Photochemists, ACS National Meeting, Boston, MA, August, *Photophysics of Metal-Organic π -Conjugated Polymers*

Department of Chemistry, University of Central Florida, Orlando, FL, March, *Chemistry of Luminescent Coatings for Imaging*

1997

Center for the Early Events in Photosynthesis, Arizona State University, Tempe, AZ, November, *Applications of Polypyridyl Re(I) Complexes. Chemistry of Radical Ions and Unique π -Conjugated Polymers*

Twelfth International Symposium on the Photochemistry and Photophysics of Coordination Compounds (ISPPCC), Saint Michaels College, VT, June, *Photophysics of Metal-Organic π -Conjugated Polymers*

American Chemical Society Florida Section Meeting, May, *Photolithographic Patterning of Electroactive Polymer Films and Electrochemically Modulated Diffraction Gratings*

Department of Chemistry, University of Maryland at College Park, April, *Applications of Polypyridyl Re(I) Complexes. From DNA to π -Conjugated Polymers*

Martech Materials Seminar, Florida State University, March, *Polymers and Light. From Electrochemistry and Photolithography to Photophysics of π -Conjugated Polymers*

Department of Chemistry, McMaster University, Hamilton, Ontario, March, *Photolithographic Patterning of Electroactive Polymer Films and Electrochemically Modulated Diffraction Gratings*

National Research Council of Canada, Ottawa, CA, March, *Photoinduced Electron Transfer in Metal-Organic Systems*

Department of Chemistry, University of Maryland at Baltimore County, February, *Applications of Polypyridyl Re(I) Complexes. From DNA to π -Conjugated Polymers*

Department of Chemistry, Ohio State University, January, *Applications of Polypyridyl Re(I) Complexes. From DNA to π -Conjugated Polymers*

1996

Annual Symposium on Photoinduced Charge Transfer, University of Rochester, Rochester, NY, June, *Photolithographic Patterning of Electroactive Polymer Films and Electrochemically Modulated Diffraction Gratings*

American Society for Photobiology National Meeting, Atlanta, GA, June, *Chromophore-Quencher Probes for DNA*

University of Wyoming, Laramie, WY, March, *Photoinduced Charge and Energy Transfer in Metal-Organic Complexes. From Radical Ions to DNA*

Florida Advanced Materials Conference, Palm Coast, Florida, March, *Photolithographic Patterning of Electroactive Polymer Films and Electrochemically Modulated Diffraction Gratings*

1995

Department of Chemistry, University of Tennessee, Chattanooga, TN, October, *Photochemistry: From Bacterial Photosynthesis to Jet Fighter Design*

Gordon Research Conference on Organic Photochemistry, July, *Photoinduced Electron Transfer in Metal-Organic Complexes*

Electrochemical Society Meeting, Reno, NV, May, *Electrochemically Modulated Optical Diffraction Gratings*

Symposium on Smart Materials, PMSE Division, ACS National Meeting, Los Angeles, April, *Photolithographically Patterned Films of Electroactive Monomers*

University of Minnesota, March, *Photochemical Probes for Electron Transfer Reactions*

3M Technical Forum, 3M Company, St. Paul, MN, March, *Electrochemically Switchable Optical Diffraction Gratings Fabricated by Microlithography*

1994

University of Chicago, October, *Photochemical Probes for Electron Transfer Reactions*

American Society for Photobiology Meeting, Phoenix, AZ, June, *Photoinduced Energy and Electron Transfer in Metal Complex Based Chromophore Quencher Complexes*

American Chemical Society, Florida Section Meeting, May, *Photochemical Probes for Electron Transfer Reactions*

Clemson University, April, *Photochemical Probes for Electron Transfer Reactions*

1993

Chemistry Division, Argonne National Laboratory, October, *Photoinduced Energy and Electron Transfer in Chromophore Quencher Complexes*

Department of Chemistry, Princeton University, Princeton, NJ, May, *Photoinduced Energy and Electron Transfer in Chromophore Quencher Complexes: Fundamentals and Application as DNA Probes*

Department of Chemistry, University of Pennsylvania, Philadelphia, PA, May, *Photoinduced Energy and Electron Transfer in Chromophore Quencher Complexes: Fundamentals and Application as DNA Probes*

DuPont Central Research, Wilmington, DE, May, *Photoinduced Energy and Electron Transfer in*

Chromophore Quencher Complexes: Fundamentals and Application as DNA Probes

Department of Chemistry, Georgia State University, Atlanta, GA, April, *Photoinduced Energy and Electron Transfer in Chromophore Quencher Complexes*

Fifth Annual Winter Conference of the Interamerican Photochemical Society, Clearwater, FL, January, *Photochemical Probes of Intramolecular Electron and Energy Transfer*

1992

European Photochemical Association Summer School on Photoinduced Energy and Electron Transfer, Rimini, Italy, September, *Studies of Intramolecular Energy and Electron Transfer Using the fac-(diimine)Re^I(CO)₃ Chromophore*

Colloid Division Award Symposium, ACS National Meeting, San Francisco, CA, April, *Ligand to Ligand Charge Transfer Photochemistry*

Rhone-Poulenc-Rorer Pharmaceutical Company, Philadelphia, PA, March, *Studies of Intramolecular Energy and Electron Transfer Using the fac-(diimine)Re^I(CO)₃ Chromophore*

Department of Chemistry, University of West Florida, Pensacola, FL, January, *Long-Range Electron Transfer: How Do Electrons Get From Here To There ?*

Department of Chemistry, University of South Alabama, Mobile, AL, January, *From Photosynthesis to Water Detoxification: Putting Photons from the Sun to Work*

1991

Florida Environmental Chemistry Conference, Palm Coast, Florida, October, *Water Remediation Using Sunlight*

Department of Chemistry, Georgia Institute of Technology, Atlanta, GA, October, *Photoinduced Charge and Energy Transfer in Metal-Organic Complexes*

NSF Sponsored US-Japan Joint Meeting on Artificial Photosynthesis Okazaki, Japan, August, *Intramolecular Charge- and Energy-Transfer in Metal-Organic Complexes*

Department of Chemistry, Tokyo Metropolitan University, Tokyo, Japan, August, *Energy Transfer in the Inverted Region*

Department of Chemistry, University of Wisconsin at Madison, March, *Photoinduced Charge- and Energy-Transfer in Metal-Organic Complexes*

Department of Chemistry, University of Kentucky, March, *Photoinduced Charge- and Energy-Transfer in Metal-Organic Complexes*

New College, Sarasota, FL, March, *Long-Range Electron Transfer: How Do Electrons Get From Here to There?*

Department of Chemistry, University of Rochester, February, *Photoinduced Electron Transfer Reactions in Supramolecular Systems*

Department of Chemistry, State University of New York at Buffalo, February, *Photoinduced Charge- and Energy-Transfer in Metal-Organic Complexes*

Third Winter Conference of The Inter-America Photochemical Society, Clearwater, January,
Photoinduced Intramolecular Electron Transfer Reactions in Re(I) Complexes

1990

Department of Chemistry, Davidson College, October, *Long Range Electron Transfer: How do Electrons Get from Here to There?*

Department of Chemistry, University of North Carolina at Chapel Hill, October, *Intramolecular Electron Transfer in Metal Complexes: Distance and Driving Force Dependence and Cation Control*

Department of Chemistry, Wake Forest University, October, *Long Range Electron Transfer: How do Electrons Get from Here to There?*

Department of Chemistry, University of Maryland, October, *Photoinduced Intramolecular Electron Transfer Reactions: Distance Dependence and Driving Force Effects*

Meeting of the Electrochemical Society, Montreal, Canada, May, *Photoinduced Electron Transfer Reactions: Distance and Driving Force Dependence*

ACS National Meeting, Boston, MA, April, *Photoinduced Intramolecular Electron Transfer Reactions in Re(I) Complexes*

Department of Chemistry, Tulane University, April, *Photoinduced Electron Transfer Reactions: Distance and Driving Force Dependence*

Department of Chemistry, University of South Florida, March, *Long Range Electron Transfer: How do Electrons Get from Here to There*

Department of Chemistry, Florida Atlantic University, February, *Long Range Electron Transfer: How do Electrons Get from Here to There*

Department of Chemistry, Florida Institute of Technology, January, *Long Range Electron Transfer: How do Electrons Get from Here to There*

1989

Department of Chemistry, Clemson University, November, *Photoinduced Intramolecular Electron Transfer Reactions in Peptide Bridged Molecules*

University of Richmond, Richmond, VA, October, *Long Range Electron Transfer: How do Electrons Get from Here to There*

Gordon Conference on Organic Photochemistry, Andover, NH, July, *Distance Dependence of Photoinduced Electron Transfer Across Peptides*

Department of Chemistry, Florida State University, Tallahassee, FL, February, *Photoinduced Intramolecular Electron Transfer Reactions in Peptide Bridged Molecules*

1987

Department of Chemistry, University of Central Florida, Orlando, FL September,

Photochemical Electron Transfer Reactions

PUBLIC AND GLOBAL OUTREACH ACTIVITIES

2011 PSP Bootcamp Lecture, “How is Scholarly Journal Content Created?”, Association of American Publishers, Washington, DC, September.

ACS Publications, ACS On Campus Outreach Event, Shandong University, Jinan, China, October.

2012 ACS On Campus Outreach Event India. Thirteen Institutes in 10 days. See *Chemical & Engineering News*, **2012**, 90(52), p. 43, <https://cen.acs.org/articles/90/i52/ACS-Publications-Visits-India.html>.

ACS On Campus Global Outreach 2013- present

10/2013 ACS On Campus Outreach Event India, part 2. Eight Institutes in 10 days.

04/2014 UNAM, Mexico City

04/2014 CINCAS, Mexico City

10/2015 KAUST, Saudi Arabia

11/2015 Harbin Institute of Technology, China

11/2015 CIAC, Changchun, China

05/2017 Shanghai Normal University, China

05/2017 Nanjing University, China

09/2017 Universidade Federale Rio Grande do Sul, Brazil

02/2018 University of Delhi, India

02/2018 IIT-Roorkee, India

02/2018 IISER-Mohali, India

05/2018 Sun Yat Sen University, China

09/2018 Benemérita Universidad Autonoma de Puebla, Mexico

09/2018 Entre Pares Peer Review Workshop, BUAP Campus, Puebla, Mexico

09/2018 Universidad de las Americas Puebla

09/2018 UNAM, Mexico City

CONTRIBUTED RESEARCH PAPERS

2002 International Symposium on Science and Technology of Synthetic Metals, Shanghai, China, July, *Near-IR Polymer Light Emitting Diodes*

Symposium on Polymers in Photonics and Displays: Synthesis, Processing, and Devices, American Chemical Society National Meeting, Boston, MA, August, *Near-IR Polymer Light Emitting Diodes*

- 2001** International Conference on Electroluminescence, Los Angeles, CA, September, *Near-IR Polymer Light Emitting Diodes*
Gordon Conference on Organic Photochemistry, New London, CT, July, *Near-IR Polymer Light Emitting Diodes*
- 2000** American Chemical Society National Meeting, San Francisco, CA, March, *Photophysics of π -Conjugated Metal-Organic Oligomers and Polymers*
- 1999** Gordon Conference on Organic Photochemistry, New London, CT, July, *Photophysics of π -Conjugated Metal-Organic Oligomers and Polymers*
- 1998** Pressure Sensitive Paint Workshop, Boeing Company, Seattle, Washington, October, *Chemistry of Temperature and Pressure Sensitive Paints*
International Conference on the Science and Technology of Synthetic Metals, Montpellier, France, July, *Photophysics of π -Conjugated Metal-Organic Oligomers and Polymers*
Inter-American Photochemical Society Meeting, Clearwater, FL, January, *Photophysics of Metal-Organic π -Conjugated Polymers*
- 1997** Gordon Conference on Organic Photochemistry, Newport Rhode Island, July, *Photophysics of Metal-Organic π -Conjugated Polymers*
- 1996** Gordon Conference on Donor-Acceptor Interactions, Newport, Rhode Island, August, *Photolithographically Patterned Films of Electroactive and Conducting Polymers*
- 1995** Inter-American Photochemical Society Meeting, Clearwater, FL, January, *Electrochemically Switchable Optical Diffraction Gratings Fabricated by Microlithography*
- 1994** IUPAC Meeting on Photochemistry, Prague, Czech Republic, July, *Photochemical Probes for Electron Transfer Reactions*
- 1993** Gordon Conference on Organic Photochemistry, Salve Regina College, Rhode Island, July, *Photochemical Probes of Intramolecular Electron Transfer*
Gordon Conference on Organic Photochemistry, Salve Regina College, Rhode Island, July, *Microstructured Photopolymer Films of Photoredox Active Molecules*
- 1992** IUPAC Meeting on Photochemistry, Leuven, Belgium, July, *Studies of Intramolecular Energy and Electron Transfer Using the fac-(diimine)Re^I(CO)₃ Chromophore*
Inter-American Photochemical Society Meeting, Clearwater, FL, January, *Photochemistry of Ligand-to-Ligand Charge Transfer Excited States*
- 1991** ACS Southeastern Regional Meeting, Richmond, VA, October, *Intramolecular Energy Transfer in the Inverted Region*
ACS National Meeting, Atlanta, GA April, *Cation Control of Photophysics in a Re(I) Fluoroionophore*
- 1990** Center for Photoinduced Charge Transfer, University of Rochester, Rochester, NY, June, *Photoinduced Electron Transfer Reactions: Distance and Driving Force Dependence*

- 1989** ACS National Meeting, Miami, FL, September, *Distance Dependence of Photoinduced Electron Transfer Across Peptides*
- IX International Symposium on Photochemistry and Photophysics of Coordination Complexes, Santa Barbara, CA, August, *Solvent Induced Excited State Quenching in a Re(I) Chromophore-Quencher Complex*
- Bienniel Inorganic Symposium, Athens, GA, March, *Photoinduced Intramolecular Electron Transfer in Peptide Bridged Molecules*
- 1988** ACS Southeastern Regional Meeting, Atlanta, GA, November, *Photochemistry of a Square Planar Co(III) Complex*
- ACS National Meeting, Los Angeles, CA, September, *Photochemistry of a Square Planar Co(III) Complex*
- ACS National Meeting, Los Angeles, CA, September, *Ligand-to-Ligand Charge Transfer Excited States of Re(I) Complexes*
- Gordon Conference on Donor-Acceptor Interactions, Wolfeboro, N.H., August, *Intramolecular Electron Transfer in Peptide-Bridged Molecules. II. Re-Proline-Amines*
- Gordon Conference on Donor-Acceptor Interactions, Wolfeboro, N.H., August, *Ligand-to-Ligand Charge Transfer Excited States of Os(II) Complexes*
- Inter-American Photochemical Society Meeting, Clearwater Beach, FL, January, *Ligand-to-Ligand Charge Transfer Excited States of Os(II) Complexes*
- 1987** Symposium on Electron Transfer Processes, ACS Northeast Regional Meeting, Rochester, N.Y., November, *Intramolecular Electron Transfer in Transition Metal Chromophore-Quencher Complexes*
- Gordon Conference on Photochemistry, Andover, N.H., July, *Intramolecular Electron Transfer in Transition Metal Chromophore-Quencher Complexes*
- Society for Photobiology National Meeting, Miami, FL, June, *Photoinduced Intramolecular Electron Transfer in Peptide Bridged Molecules*
- 1986** Gordon Conference on Donor-Acceptor Interactions, Plymouth State College, N.H., August, *Photoinduced Intramolecular Electron Transfer in Peptide Bridged Molecules*
- 1985** Physical Chemistry General Session, ACS Western Regional Meeting, San Francisco, CA, *Photoinduced Intramolecular Electron Transfer in Peptide Bridged Molecules*
- 1983** Symposium on Organized Media, ACS Southeastern Regional Meeting, Charlotte, NC, *Photophysics of a Substituted Stilbene in Micelles and Vesicles: Evidence for Heterogeneous Solubilization Sites*
- 1982** Symposium on Characterization and Analytical Applications of Ordered Media, ACS Eastern Regional Meeting, White Haven, PA, *The use of an Isomerizable Solute Probe to Investigate Solubilization Sites in Surfactant Aggregates*

CONTRACTS AND GRANTS (CAREER FUNDING > \$10,000,000)

- 1987 – 1989 Amoco Research Corporation, \$88,000
“Photooxidation Reactions of First Row Transition Metal Complexes”

- 1987 – 1989 Petroleum Research Foundation, \$18,000
“Photoinduced Electron Transfer: Distance Dependence as a Function of Donor and Acceptor Energies”
- 1987 – 1989 UF Division of Sponsored Research, \$25,000
“Study of the Binding of Peptides to Micelles”
- 1989 - 1990 UF Biomedical Research Support Grant, \$50,000
“A Molecular Modeling and Graphics Facility for Chemistry”
- 1989 - 1991 Petroleum Research Fund, \$40,000
“Ligand-Ligand Charge Transfer Excited States of Re(I) Complexes”
- 1990 - 1991 UF Division of Sponsored Research, \$7,500
“Long Range Electron Transfer Reactions”
- 1990 - 1991 National Renewable Energy Laboratory, \$100,000 (KSS co-PI with three mechanical engineering faculty members)
“Development of a One-Sun Solar Water Detox System”
- 1991 - 1993 Petroleum Research Fund, \$43,000
“Intramolecular Charge- and Energy-Transfer in Metal-Organic Systems”
- 1992 - 1994 National Science Foundation, Chemistry Division, \$144,000
“Photochemistry of Charge Transfer Excited States”
- 1992 - 1993 UF Division of Sponsored Research, \$25,000
“Spatially Resolved Chemical Synthesis: Preparation of Novel Materials for Electronic and Photonic Applications”
- 1994 - 1997 National Science Foundation, Chemistry Division, \$280,000
“Charge Transfer Photochemistry in Metal-Organic Complexes”
- 1994 - 1995 UF Division of Sponsored Research, \$10,000
“Redox Active Photopolymer Films”
- 1994 - 1995 McDonnell-Douglas Aerospace, \$19,000
“Luminescent Paints for Real-Time Stress Analysis”
- 1995 - 1996 McDonnell-Douglas Aerospace, \$30,000
“Luminescent Paints for Real-Time Stress Analysis”
- 1996 Ford Motor Company, \$380,000 (KSS co-PI with two engineering faculty)
“Strain Sensitive Paints”
- 1996 - 1997 NASA Langley Research Center, \$150,000
“Temperature Sensitive Paints for Cryogenic Wind Tunnels”
- 1996 - 1998 Petroleum Research Fund, \$50,000
“Electrochemically Modulated Diffraction in Microstructured Photopolymer Films”
- 1997 Ford Motor Company, \$330,000 (KSS co-PI with two engineering faculty)
“Strain Sensitive Paints. Phase II Development”

- 1998 - 1999 NASA Langley Research Center, \$150,000
 “Temperature Sensitive Paints for Cryogenic Wind Tunnels. Phase II Studies”
- 1998 - 1999 McDonnell-Douglas Aerospace, \$50,000 (KSS co-PI with Dr. Bruce Carroll of AeMES)
 “Development of Dual Luminophore Pressure Sensitive Paints”
- 1999 Visteon Company, \$298,000 (KSS co-PI with one engineering faculty)
 “Strain Sensitive Paints. Phase III Development.”
- 1999 - 2000 NASA Langley Research Center, \$100,000
 “Advanced Particles for Wind Tunnel Testing”
- 1999 - 2001 Aerochem, Inc (UF subcontract on Army SBIR program), \$144,000
 “Advanced Pressure- and Temperature-Sensitive Paints”
- 1999 - 2002 National Science Foundation, Chemistry Division, \$335,000
 “Photophysics of Mono-Disperse π -Conjugated Metal-Organic Oligomers”
- 1999 - 2000 National Science Foundation, International Division, \$22,000
 “Photosynthesis and Energy Conversion: A US-Japan Workshop”
- 2000 Visteon Company, \$200,000 (KSS co-PI with one engineering faculty)
 “Strain Sensitive Paints. Phase IV Development”
- 2000 - 2001 DARPA: UF MINSA Center, \$375,000 (KSS co-PI with two chemistry faculty. Chemistry component of UF center project directed by Dr. P. Holloway of MSE)
 “Infrared Organic Light Emitting Diodes”
- 2001 Visteon Company, \$200,000 (KSS co-PI with one engineering faculty)
 “Strain Sensitive Paints. Phase V Development”
- 2001 - 2003 DARPA: UF MINSA Center \$250,000 (KSS co-PI with two chemistry faculty. Schanze component of UF center project directed by Prof. P. Holloway of MSE)
 “Infrared Organic Light Emitting Diodes and Polyelectrolyte Sensors”
- 2002 Visteon Company, \$200,000 (KSS co-PI with one engineering faculty)
 “Strain Sensitive Paints. Phase VI Development”
- 2002 – 2005 National Science Foundation, Chemistry Division, \$345,000
 “Photophysics of π -Conjugated Metal-Organic Oligomers”
- 2002 - 2003 Air Force Research Laboratory/Anteon Corporation, \$50,000
 “Agile Damage Research and Development”
- 2003 - 2006 Air Force Office of Scientific Research, \$330,000
 “Platinum Acetylide Materials for Optical Limiting”
- 2003 Visteon Company, \$225,000 (KSS co-PI with two engineering faculty)
 “Enhancements for Strain Sensitive Skin (S3)”
- 2003 – 2006 Dept. of Energy, \$880,000 (KSS PI, J. Reynolds and Valeria Kleiman co-PIs)
 “Nanoscale Assemblies for Optical Energy Conversion”

- 2005 – 2006 UF RGP Opportunity Seed Fund, \$100,000 (J. Reynolds PI, K. Schanze co-PI).
 “Inert Atmosphere Processing of Advanced Electronic and Optical Materials and Devices”,
- 2005 – 2008 Wake Forest University (Air Force Office of Scientific Research primary sponsor) \$200,000 (J. Reynolds PI, K. S. Schanze co-PI)
 “Agile Response Coatings”
- 2005 – 2008 Vanderbilt University (Army Research Office primary sponsor) \$237,000 (J. Reynolds, PI, K. S. Schanze co-PI)
 “Advanced Carbon Nanotechnology Consortium: Displays and Detectors”,
- 2005 – 2008 National Science Foundation, Chemistry Division, \$396,000
 “Photophysics, Exciton and Charge Transport in Conjugated Organometallic Oligomers and Aggregates”
- 2006 - 2009 Air Force Office of Scientific Research, \$395,000
 “Second Generation Organometallic Materials for Optical Limiting”
- 2006 - 2007 Florida High Tech Corridor, \$100,000 (UF-RGP match to industry, T. Morey PI, K. S. Schanze, co-PI)
 “Development of an Exhaled Breath Glucose Monitor”
- 2007 – 2010 Department of Energy, \$930,000 (KSS PI, J. Reynolds & Valeria Kleiman co-PIs)
 “Nanoscale Assemblies of Conjugated Polyelectrolytes. Energy Transport, Energy Transduction and Photoconversion”
- 2007 – 2011 Defense Threat Reduction Agency (DTRA), \$354,000 (KSS sub-contract to University of New Mexico)
 “Elucidating the Role of Conjugated Polyelectrolytes as Sensitizers of Reactive Oxygen Species as Versatile Antimicrobials”
- 2007 - 2010 Defense Threat Reduction Agency (DTRA), \$126,600 (KSS sub-contract to University of New Mexico)
 “Controlling Biological Surface Adhesion and Release”
- 2008 – 2011 National Science Foundation, Chemistry Division, \$294,000
 Special Creativity Extension Grant
 “Photophysics, Exciton and Charge Transport in Conjugated Organometallic Oligomers and Aggregates”
- 2008 – 2011 Defense Advanced Research Projects Agency, Total Grant : \$1,450,000, KSS co-PI with 7 other PIs. (KS share is \$145,000)
 “Extreme Light Sources”
- 2008 – 2010 Solar Powered Grass, LLC and Florida High Tech Corridor, Total Grant : \$380,000, KSS co-PI with 3 others (KS Share is \$83,000)

“Solar Powered Grass”

- 2008 – 2011 Department of Energy, Total Grant : \$1,050,000, KSS co-PI with 3 others (KS share is \$203,000)
“Very High Efficiency. Hybrid Organic-Inorganic Photovoltaic Cells”
- 2009 – 2014 Air Force Office of Scientific Research, \$780,785
“Chromophores and Materials for Temporal and Frequency Agile Non-Linear Absorption”
- 2009 – 2016 Department of Energy (UF Subcontract to EFRC program, \$950,000
UNC-EFRC “Solar Fuels and Next Generation Photovoltaics”
- 2009 – 2011 National Science Foundation
“The Inorganic Chemistry Workshop”
\$40,000 (KSS is the PI, J. Boncella and J. Morrow, co-PIs)
- 2010 – 2014 Department of Energy, Basic Energy Sciences Photochemistry Program
\$1,250,000 (KSS is the PI, J. Reynolds and Valeria Kleiman co-PIs)
“Conjugated Polymers and Polyelectrolytes in Solar Photoconversion”
- 2010 Sestar, LLC, Total Grant : \$350,000, KSS co-PI with 3 others (KS Share is \$91,000)
“Solar Powered Grass”
- 2010 – 2011 Konarka, LLC, \$100,000
“Triplet States in Organic Solar Cells”
- 2011 – 2016 Defense Threat Reduction Agency (DTRA), \$350,000 (KSS sub-contract to University of New Mexico)
“Controllable Adhesion, Detection, and Release of CBW Agents by Multifunctional ‘Smart’ Nanoscale Surfaces”
- 2011 – 2014 Montana State University (AFOSR Prime), \$125,000
“Advanced Multi-Photon Chromophores for Broad-Band Ultra-Fast Optical Limiting”
- 2011 Pennsylvania State University (DTRA Prime), \$25,000
“Collaborative Research with North Carolina AT&T University”
- 2012 – 2015 National Science Foundation, Chemistry Division, \$453,200
“Triplet Structure and Dynamics in Organometallic Oligomers and Polymers”
- 2012 University of New Mexico (subcontract, \$19,163 to KS)
“Scale-Up Synthesis and Development of Synthetic Protocols for Biocidal Polymers and Oligomers”
- 2012 – 2013 U.S. Navy, \$7,500

ACS Symposium on Biocidal Materials and Interfaces

- 2014 – 2017 BOE Technology Co., \$850,000 (\$425,000 to KSS PI with F. So co-PI MSE)
“High Efficiency OLEDs for Displays”
- 2014 – 2018 Department of Energy (UF Subcontract to EFRC program, \$560,000)
UNC-Solar Fuels EFRC Phase II
- 2015 – 2019 National Science Foundation, Chemistry Division, \$520,000
“Triplet Photophysics in Donor-Acceptor and pi-Conjugated Systems”
- 2019 – 2022 National Science Foundation, Chemistry Division, \$520,000
“Fundamental Properties and Applications of pi-Conjugated Platinum Carbene Chromophores and Polymers”
- 2019 – 2022 Department of Energy, Materials Chemistry Division, \$190,715 (sub-contract to University of Florida), “iClick Molecules and Polymers for Light Emission”
- 2020 – 2023 Air Force Office of Scientific Research, Materials Chemistry Program, \$580,000,
“Optical Control of Charge and Energy Transfer in Molecular Wires”
- 2021 – 2022 King Abdullah University of Science and Technology, \$100,000,
“Panchromatic Metal Organic Framework Materials”
- 2022 – 2025 Department of Energy, Materials Chemistry Division, \$189,994 (sub-contract to University of Florida), “Expanding iClick to Link Metal Ions in Multidimensional Metallopolymers and Materials Synthesis”
- 2023 – 2026 National Science Foundation, Chemistry Division, \$475,104, “Collaborative Research: Photophysics and Electron Transfer Reactivity of Ion Radical Excited States”
- 2023 – 2026 Air Force Office of Scientific Research, Materials Chemistry Program, \$515,309,
“Excited State Dynamics in Diblock pi-Conjugated Oligomers and Polymers”

THESES AND DISSERTATIONS ADVISED

M.S. Theses

1. L. A. Cabana, “Photoinduced Long-Range Electron Transfer in Proline Bridged Rhenium(I) Chromophore-Quencher Complexes”, 1992
2. L. A. Lucia, “The MLCT Photochemistry of Selected Mononuclear Rhenium(I) Organometallic Complexes”, 1993
3. B. M. McCosar, “The Use of Reactive Electron Donors in Photoredox Chemistry”, 1997
4. Lijuan Huang, “Alkaline Phosphatase Sensors Based on Amplified Quenching of Conjugated Polyelectrolytes”, 2008.

5. Aaron Eshbaugh, “Green Dye-Sensitized Solar Cells”, 2010.
6. Kim Anh Nguyen, “Photoelectrochemical Oxidation of Organic Substrates Using a Dye-Sensitized TiO₂ Photoanode”, 2020. – UT San Antonio
7. Isai Barboza, “Imidazolium Functionalized Cationic Conjugated Polyelectrolytes with Light-Activated Antifungal Activity” 2020. – UT San Antonio

Ph.D. Dissertations

1. T. A. Perkins, “Photoinduced Electron Transfer in Osmium(II) and Rhenium(I) Chromophore-Quencher Complexes”, 1991
2. Y. Wang, “Photochemical Probes for Intramolecular Electron Transfer”, 1994
3. N. B. Thornton, “Chromophore-Quencher Based Luminescence Probes for DNA”, 1995
4. L. A. Lucia, “MLCT Sensitized Intermolecular and Intramolecular Photoreactivity of Re(I) Complexes, 1996
5. B. T. Hauser, “Electrochemical, Optical and Photophysical Properties of Polypyridyl Complexes of Ru(II) and Os(II) in Polymer Films”, 1996
6. T. S. Bergstedt, “Photolithographic Fabrication of Electroactive Polymer Microstructures and Electrochemically Modulated Optical Diffraction Gratings”, 1999
7. K. D. Ley, “Photophysics of π -Conjugated Polymers and Oligomers that Incorporate MLCT Chromophores”, 2000
8. K. A. Walters, “Photophysical Studies of π -Conjugated Oligomers and Polymers that Incorporate MLCT Chromophores”, 2000
9. J. M. Bedlek-Anslow, “Development and Characterization of Luminescent Oxygen Sensing Coatings”, 2000
10. C. E. Whittle, “Electron Transfer Within Various Organometallic Species”, 2000
11. Y. Li, “Synthesis and Photophysics of mono-Disperse Phenylene Ethynylene Oligomers that Feature Ru(II), Os(II) and Re(I) Polypyridine Complexes”, 2001
12. Benjamin Harrison, “Near-IR Photoluminescent and Electroluminescent Materials and Devices”, 2003.
13. Ksenija Glusac, “Photophysics of Conjugated Platinum Acetylide Oligomers and Polymers”, 2003
14. Shengxia Liu, “Photophysics of Conjugated Polymers and Oligomers that Contain Transition Metal Chromophores”, 2004
15. Chunyan Tan, “Conjugated Polyelectrolytes: Amplified Quenching, Self-Assembly and Sensor Applications”, 2004
16. M. Erkan Kose, “Multi-Lumiophore Coatings for Pressure Sensitive Paint Applications”, 2005
17. Eric Silverman, “Photophysics of Single Chain poly(Arylene Ethynylene)s”, 2005

18. Thomas Cardolaccia, "From Molecular Oligomers to Supramolecular Gels: Photophysics of Conjugated Metal-Organic Systems", 2005
19. Garry Cunningham, "Near-Infrared Polymer Light Emitting Diodes", 2005
20. John D. Peak, "Dual Mechanism Nonlinear Response of Selected Metal Organic Chromophores", 2007
21. Xiaoyong Zhao, "Conjugated Polyelectrolytes Based on poly(Arylene Ethynylene). Synthesis, Solution Photophysics, and Applications to Sensors and Solar Cells", 2007
22. Richard T. Farley, "Photophysics of Platinum and Iridium Organometallic Materials from Molecular Wires to Nonlinear Optics", 2007
23. Yan Liu, "Conjugated Polyelectrolytes Based on poly(Paraphenylene Ethynylene): Fluorescent and Chemiluminescent Sensors, 2008.
24. Yongjun Li, "Photophysics of Conjugated Organometallic Systems: Photoinduced Electron and Energy Transfer. Triplet Exciton Delocalization, and Phosphorescent Organogelators", 2009
25. Eunkyung Ji, "Conjugated Polyelectrolytes: Synthesis, Photophysical Studies and Applications to Sensors and Biocidal Activity", 2009.
26. Jarrett Vella, "Singlet and Triplet Excitons in Organic and Organometallic Thin Films: Diffusion and Triplet Sensitization", 2009.
27. Julia M. Keller, "Characterization of Polarons and Excitons in Monodisperse Platinum Acetylide Materials", 2010.
28. Jonathan R. Sommer, "Synthesis and Photophysical Characterization of Extended-Conjugation Platinum Porphyrins for Application in High Efficiency Near-Infrared Light Emitting Diodes", 2010.
29. Seoung Ho Lee, "Photoactive Conjugated Polyelectrolytes and Conjugated Polyelectrolyte Dendrimers", 2010.
30. Abigail H. Shelton, "Synthesis and Photophysical Characterization of pi-Conjugated Nonlinear Absorbing Organometallic Platinum Complexes", 2011.
31. Dongping Xie, "Fundmental and Applied Study of Conjugated Polyelectrolytes", 2012.
32. Danlu Wu, "Investigation of Conjugated Polyelectrolytes and Their Protein Sensing by Fluorescence Correlation Spectroscopy", 2012.
33. Jie Yang, "Studies of Conjugated Polyelectrolytes using Fluorescence Correlation Spectroscopy", 2013.
34. Zhuo Chen, "Light Harvesting Polymers: Energy Transfer and Materials Applications", 2013.
35. Xuzhi Zhu, "Conjugated Polyelectrolytes: Synthesis, Photophysics, Aggregation Studies and Sensor Applications", 2013.
36. Randi Price, "Excited State Properties of Organic and Organometallic Oligomers, Polymers, and Materials and their Solid-State Applications", 2013.
37. Hsien-Yi Hsu, "Exciton Diffusion and Electron Transfer of Platinum-Acetylide Polymers and Their Solid State Photophysics", 2014.

38. Ali Gundogan, "Synthesis and Photophysical Characterization of Organometallic Platinum Complexes with Donor-Acceptor Chromophores and Effects of Direct Metallation", 2014.
39. Zhenxing Pan, "Different Chain Length Conjugated Polymers: Photophysical Studies and Dye-Sensitized Solar Cell Applications", 2015
40. Subhadip Goswami, "Organometallic Pi-Conjugated Materials: Fundamental Investigations and Exploring Applications in Optoelectronics", 2015.
41. Russell Winkel, "Look into the Light: Tuning Platinum Acetylide Complexes for Enhanced Photophysical Properties", 2015
42. Seda Cekli, "Triplet State Properties of pi-Conjugated Donor-Acceptor-Donor Chromophores, 2016.
43. Amy Shanshan Wang, "Conjugated Polyelectrolytes: Interactions with Molecules, Biological Species and Applications in Sensing and Fluorescence Imaging", 2016.
44. Junlin Jiang, "Charge Transfer Studies in Molecular Donor-Acceptor System and Applications in Polymer Based Solar Energy Conversion", 2016.
45. Ethan D. Holt, "Exploiting Photophysical Properties in Conjugated Chromophores for Organic Solar Cells", 2017
46. Bethy Kim, "Investigation of Photophysical Properties for Poly(phenylene ethynylene)-Based Conjugated Polyelectrolytes via Chain-Growth Polymerization", 2017
47. Julian Wang, "The Interaction Between Perfluoro-Arynes and Conjugated Polymers and its Application in Polymer Solar Cells", 2017.
48. Austin Jones, Electron Transfer in Donor-Acceptor Conjugated Oligomers, 2017.
49. Zhiliang Li, "Photophysics, Phosphate Sensing and Self-assembling of Cationic poly(phenylene ethynylene) Conjugated Polyelectrolytes and Porphyrin with Branched Ammonium Side Groups", 2018.
50. Yun Huang, "Functionalized Conjugated Polyelectrolytes for Biological Applications", 2018.
51. James D. Bullock, "Trans-N-Heterocyclic Carbene Platinum(II) Acetylides and their Application in Deep Blue Organic Light Emitting Diodes", 2018.
52. Yajing Yang, "Study on Fluorescence Quenching, Aggregation and Charge Transfer Properties of Conjugated Polymers", 2019.
53. C. Jason Zeman, "Computational and Spectroscopic Analysis of the Photophysical and Structural Properties of Conjugated Compounds", 2019.
54. Ru He, "Novel trans-N-Heterocyclic Carbene Platinum(II) Complexes", 2020.
55. Soojin Kim, "Novel Sensitizers and Chromophore-Catalyst Assemblies for Photocatalysis", 2020.
56. Ziqi Yu, "Confocal Microscope Studies of Polycyclic Aromatic Hydrocarbons and Semiconductor Single Nanoparticles", 2023
57. Amran Al-Taz Khan, "Exploring Metal-NHC Complexes for Optoelectronic Applications: Photophysics and Tunable Emission Properties", 2023

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