



020806

PTO/SB/05 (04-05)

Approved for use through 07/31/2006. OMB 0651-0032

U.S. Patent and Trademark Office. U.S. DEPARTMENT OF COMMERCE

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UTILITY PATENT APPLICATION TRANSMITTAL (Only for new nonprovisional applications under 37 CFR 1.53(b))		Attorney Docket No. HSJ920050318US1 First Inventor Hardayal Singh Gill Title Magnetic Tunnel Transistor with ... Express Mail Label No. EV568338991 US	
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APPLICATION ELEMENTS See MPEP chapter 600 concerning utility patent application contents.		ADDRESS TO: Commissioner for Patents P.O. Box 1450 Alexandria VA 22313-1450	
1. ☒ Fee Transmittal Form (e.g., PTO/SB/17) (Submit an original and a duplicate for fee processing) 2. ☐ Applicant claims small entity status. See 37 CFR 1.27. 3. ☒ Specification [Total Pages <u>10</u>] Both the claims and abstract must start on a new page (For information on the preferred arrangement, see MPEP 608.01(a)) 4. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets <u>1</u>] 5. Oath or Declaration [Total Sheets <u>2</u>] a. ☒ Newly executed (original or copy) b. ☐ A copy from a prior application (37 CFR 1.63(d)) (for continuation/divisional with Box 18 completed) i. ☐ DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) name in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b). 6. ☐ Application Data Sheet. See 37 CFR 1.76 7. ☐ CD-ROM or CD-R in duplicate, large table or Computer Program (Appendix) ☐ Landscape Table on CD 8. Nucleotide and/or Amino Acid Sequence Submission (if applicable, items a. - c. are required) a. ☐ Computer Readable Form (CRF) b. ☐ Specification Sequence Listing on: i. ☐ CD-ROM or CD-R (2 copies); or ii. ☐ Paper c. ☐ Statements verifying identity of above copies		ACCOMPANYING APPLICATION PARTS 9. ☐ Assignment Papers (cover sheet & document(s)) Name of Assignee _____ 10. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney (when there is an assignee) 11. ☐ English Translation Document (if applicable) 12. ☒ Information Disclosure Statement (PTO/SB/08 or PTO-1449) ☐ Copies of citations attached 13. ☐ Preliminary Amendment 14. ☒ Return Receipt Postcard (MPEP 503) (Should be specifically itemized) 15. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed) 16. ☐ Nonpublication Request under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent. 17. ☐ Other: _____	
18. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in the first sentence of the specification following the title, or in an Application Data Sheet under 37 CFR 1.76: ☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: _____ Prior application information: Examiner: _____ Art Unit: _____			
19. CORRESPONDENCE ADDRESS			
☒ The address associated with Customer Number: 24955 OR ☐ Correspondence address below			
Name			
Address			
City		State	Zip Code
Country		Telephone	Email
Signature		Date	
Name (Print/Type)		Registration No.	
JOHN L. ROGITZ		February 8, 2006 33,549	

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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020806

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Effective on 12/08/2004. Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818). FEE TRANSMITTAL For FY 2005		Complete if Known		
☐ Applicant claims small entity status. See 37 CFR 1.27		Application Number		
		Filing Date	Herewith	
		First Named Inventor	Hardayal Singh Gill	
		Examiner Name		
		Art Unit		
TOTAL AMOUNT OF PAYMENT	(\$)	1000	Attorney Docket No.	HSJ920050318US1

METHOD OF PAYMENT (check all that apply)	
☐ Check ☐ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): _____	
☒ Deposit Account Deposit Account Number: <u>50-2587</u> Deposit Account Name: <u>Hitachi Global Storage</u>	
For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)	
☒ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, except for the filing fee	
☒ Charge any additional fee(s) or underpayments of fee(s) under 37 CFR 1.16 and 1.17 ☒ Credit any overpayments	
WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.	

FEE CALCULATION							
1. BASIC FILING, SEARCH, AND EXAMINATION FEES							
Application Type	FILING FEES		SEARCH FEES		EXAMINATION FEES		Fees Paid (\$)
	Fee (\$)	Small Entity Fee (\$)	Fee (\$)	Small Entity Fee (\$)	Fee (\$)	Small Entity Fee (\$)	
Utility	300	150	500	250	200	100	1000
Design	200	100	100	50	130	65	
Plant	200	100	300	150	160	80	
Reissue	300	150	500	250	600	300	
Provisional	200	100	0	0	0	0	
2. EXCESS CLAIM FEES							
Fee Description						Fee (\$)	Small Entity Fee (\$)
Each claim over 20 (including Reissues)						50	25
Each independent claim over 3 (including Reissues)						200	100
Multiple dependent claims						360	180
Total Claims		Extra Claims	Fee (\$)	Fee Paid (\$)	Multiple Dependent Claims		
20 - 20 or HP = 0		x	50	= 0	Fee (\$) Fee Paid (\$)		
HP = highest number of total claims paid for, if greater than 20.							
Indep. Claims		Extra Claims	Fee (\$)	Fee Paid (\$)			
3 - 3 or HP = 0		x	200	= 0			
HP = highest number of independent claims paid for, if greater than 3.							
3. APPLICATION SIZE FEE							
If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).							
Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee (\$)	Fee Paid (\$)			
- 100 =	/ 50 =	(round up to a whole number) x					
4. OTHER FEE(S)							
Non-English Specification, \$130 fee (no small entity discount)						Fees Paid (\$)	
Other (e.g., late filing surcharge):							

SUBMITTED BY		
Signature		Registration No. (Attorney/Agent) 33,549
Name (Print/Type)	JOHN L. ROGITZ	Telephone 619.338.8075
		Date February 8, 2004

This collection of information is required by 37 CFR 1.136. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

MAGNETIC TUNNEL TRANSISTOR WITH THIN READ GAP FOR HEAD APPLICATIONS

I. Field of the Invention

The present invention generally relates to magnetic tunnel transistors (MTT) for, e.g., disk drive read heads.

II. Background of the Invention

In magnetic disk drives, data is written and read by magnetic transducers called "heads." The magnetic disks are rotated at high speeds, producing a thin layer of air called an air bearing surface (ABS). The read and write heads are supported over the rotating disk by the ABS, where they either induce or detect flux on the magnetic disk, thereby either writing or reading data. Layered thin film structures are typically used in the manufacture of read and write heads. In write heads, thin film structures provide high areal density, which is the amount of data stored per unit of disk surface area, and in read heads they provide high resolution.

The present invention is directed generally to devices that can be used, in some implementations, as heads for disk drives, and more particularly the present invention is directed to magnetic tunnel transistors (MTT). A magnetic tunnel transistor (MTT) includes a ferromagnetic emitter, such as cobalt Iron (CoFe), a tunnel barrier, a single ultrathin ferromagnetic base layer, and a collector that heretofore has been made of GaAs.

As recognized herein, the use of GaAs as a collector is not as compatible in read head sensor applications as might be hoped. The present invention understands that preferably, only so-called "hot" electrons, also referred to as "ballistic" electrons, tunnel from the emitter through the base to the collector, because such electrons advantageously do not undesirably scatter. It is thus desirable to preferentially select "hot" electrons and to de-select lower energy electrons. With these recognitions in mind, the invention herein is provided.

SUMMARY OF THE INVENTION

A read head for a disk drive includes a magnetic tunnel transistor (MTT) that has a barrier of TiO disposed between a ferromagnetic collector and a ferromagnetic base.

In another aspect, a magnetic tunnel transistor (MTT) has a ferromagnetic base, a ferromagnetic emitter structure, and a ferromagnetic collector that does not include GaAs. A barrier layer of TiO may be disposed between the collector and the base.

In non-limiting implementations a barrier layer of MgO can be disposed between the base and the emitter structure. The collector may be made of NiFe and/or CoFe, the base may be made of CoFeB, and the emitter structure can include a layer of Ru disposed between a layer of CoFeB and a layer of CoFe. The emitter structure can be pinned if desired by a pinning layer.

In yet another aspect, a magnetic tunnel transistor (MTT) includes a ferromagnetic base, a ferromagnetic emitter structure, and a ferromagnetic collector. A barrier layer is

between the collector and base. The barrier layer has a barrier height of less than three-tenths of an electron volt. The barrier layer may be, e.g., TiO.

The details of the present invention, both as to its structure and operation, can best be understood in reference to the accompanying drawings, in which like reference numerals refer to like parts, and in which:

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic plan view of a hard disk drive, showing one non-limiting environment for the present invention; and

Figure 2 is an elevational view of a MTT in accordance with present principles.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring initially to Figure 1, a magnetic disk drive 30 includes a spindle 32 that supports and rotates a magnetic disk 34. The spindle 32 is rotated by a spindle motor that is controlled by a motor controller which may be implemented in the electronics of the drive. A slider 42 has a combined read and write magnetic head 40 and is supported by a suspension 44 and actuator arm 46 that is rotatably positioned by an actuator 47. The read head portion may be a MTT described below. It is to be understood that a plurality of disks, sliders and suspensions may be employed. The suspension 44 and actuator arm 46 are moved by the actuator 47 to position the slider 42 so that the magnetic head 40 is in a transducing relationship with a surface of the magnetic disk 34. When the disk 34 is rotated

by the spindle motor 36 the slider is supported on a thin cushion of air known as the air bearing that exists between the surface of the disk 34 and an air bearing surface (ABS) of the head. The magnetic head 40 may then be employed for writing information to multiple circular tracks on the surface of the disk 34, as well as for reading information therefrom. To this end, processing circuitry 50 exchanges signals, representing such information, with the head 40, provides spindle motor drive signals for rotating the magnetic disk 34, and provides control signals to the actuator for moving the slider to various tracks. The components described above may be mounted on a housing 55.

Now referring to Figure 2, the present read head, generally designated 10, includes a ferromagnetic collector 12, designated "S1" in Figure 2, that may be made of, e.g., NiFe or CoFe. Laying against the collector 12 is a first barrier layer 14 made of TiO and having a barrier height of one-tenth to three-tenths (0.1-0.3) electron-volts (ev).

A ferromagnetic base 16 lies against the first barrier layer 14 as shown. In one implementation the base 16 is made of CoFeB. A second barrier layer 18 lies against the base 16. The second barrier layer 18 may be, e.g., MgO and in non-limiting implementations may have a thickness of twenty Angstroms and a barrier height of four-tenths of an electron volt (0.4 ev).

A stack of layers that establishes a ferromagnetic emitter is on the second barrier layer 18. More specifically, a non-limiting CoFeB layer 20 lies against the second barrier layer 18, a non-limiting Ru layer 22 can lie on the CoFeB layer 20, and a non-limiting CoFe layer 24 can lie on the Ru layer 22. If it is desired to pin the emitter, a pinning layer 26 that can be,

e.g., IrMn, can be deposited on the CoFe layer 24. A protective cap 28 such as but not limited to Ta can be on the pinning layer 26, and a shield 29, designated "S2" in Figure 2, can be on the cap 28.

The above structure may be established by deposition, etching, and milling processes known in the art. The external connections to the base, emitter, and collector are effected in accordance with principles known in the art and are omitted for simplicity.

The above structure, owing at least in part to the TiO barrier layer 14, advantageously permits hot electrons to tunnel through the second barrier layer 18, while screening out lower energy electrons that otherwise may undesirably scatter.

While the particular MAGNETIC TUNNEL TRANSISTOR WITH THIN READ GAP FOR HEAD APPLICATIONS as herein shown and described in detail is fully capable of attaining the above-described objects of the invention, it is to be understood that it is the presently preferred embodiment of the present invention and is thus representative of the subject matter which is broadly contemplated by the present invention, that the scope of the present invention fully encompasses other embodiments which may become obvious to those skilled in the art, and that the scope of the present invention is accordingly to be limited by nothing other than the appended claims, in which reference to an element in the singular is not intended to mean "one and only one" unless explicitly so stated, but rather "one or more".

It is not necessary for a device or method to address each and every problem sought to be solved by the present invention, for it to be encompassed by the present claims. Furthermore, no element, component, or method step in the present disclosure is intended to be dedicated

to the public regardless of whether the element, component, or method step is explicitly recited in the claims. Absent express definitions herein, claim terms are to be given all ordinary and accustomed meanings that are not irreconcilable with the present specification and file history.

WHAT IS CLAIMED IS:

1. A magnetic tunnel transistor (MTT) comprising:
a ferromagnetic base;
a ferromagnetic emitter structure; and
a ferromagnetic collector that does not include GaAs.
2. The MTT of Claim 1, comprising a barrier layer of TiO disposed between the collector and the base.
3. The MTT of Claim 2, comprising a barrier layer of MgO disposed between the base and the emitter structure.
4. The MTT of Claim 2, wherein the collector is made of NiFe and/or CoFe.
5. The MTT of Claim 2, wherein the base is made of CoFeB.
6. The MTT of Claim 2, wherein the emitter structure includes a layer of Ru disposed between a layer of CoFeB and a layer of CoFe.
7. The MTT of Claim 6, wherein the emitter structure is pinned by a pinning layer.

-)
8. A magnetic tunnel transistor (MTT) comprising:
 - a ferromagnetic base;
 - a ferromagnetic emitter structure;
 - a ferromagnetic collector; and
 - a barrier layer between the collector and base and having a barrier height of less than three-tenths of an electron volt.
 9. The MTT of Claim 8, wherein the barrier layer is made of TiO.
 10. The MTT of Claim 9, wherein the collector does not include GaAs.
 11. The MTT of Claim 9, comprising a barrier layer of MgO disposed between the base and the emitter structure.
 12. The MTT of Claim 9, wherein the collector is made of NiFe and/or CoFe.
 13. The MTT of Claim 9, wherein the base is made of CoFeB.
 14. The MTT of Claim 9, wherein the emitter structure includes a layer of Ru disposed between a layer of CoFeB and a layer of CoFe.

15. The MTT of Claim 14, wherein the emitter structure is pinned by a pinning layer.
16. A read head for a disk drive, comprising:
a magnetic tunnel transistor (MTT) including a barrier of TiO disposed between a ferromagnetic collector and a ferromagnetic base.
17. The read head of Claim 16, in combination with a disk drive.
18. The read head of Claim 16, comprising an emitter structure separated from the base by a barrier.
19. The read head of Claim 16, wherein the collector does not include GaAs.
20. The read head of Claim 18, wherein the collector is made of NiFe and/or CoFe, the base is made of CoFeB, and the emitter structure includes a layer of Ru disposed between a layer of CoFeB and a layer of CoFe.

MAGNETIC TUNNEL TRANSISTOR WITH THIN READ GAP FOR HEAD APPLICATIONS

ABSTRACT OF THE DISCLOSURE

A magnetic tunnel transistor (MTT) for a disk drive read head includes a barrier of TiO disposed between a ferromagnetic collector and a ferromagnetic base for preferentially selecting only "hot" electrons for propagation to the collector.

BEST AVAILABLE COPY

Fig. 1

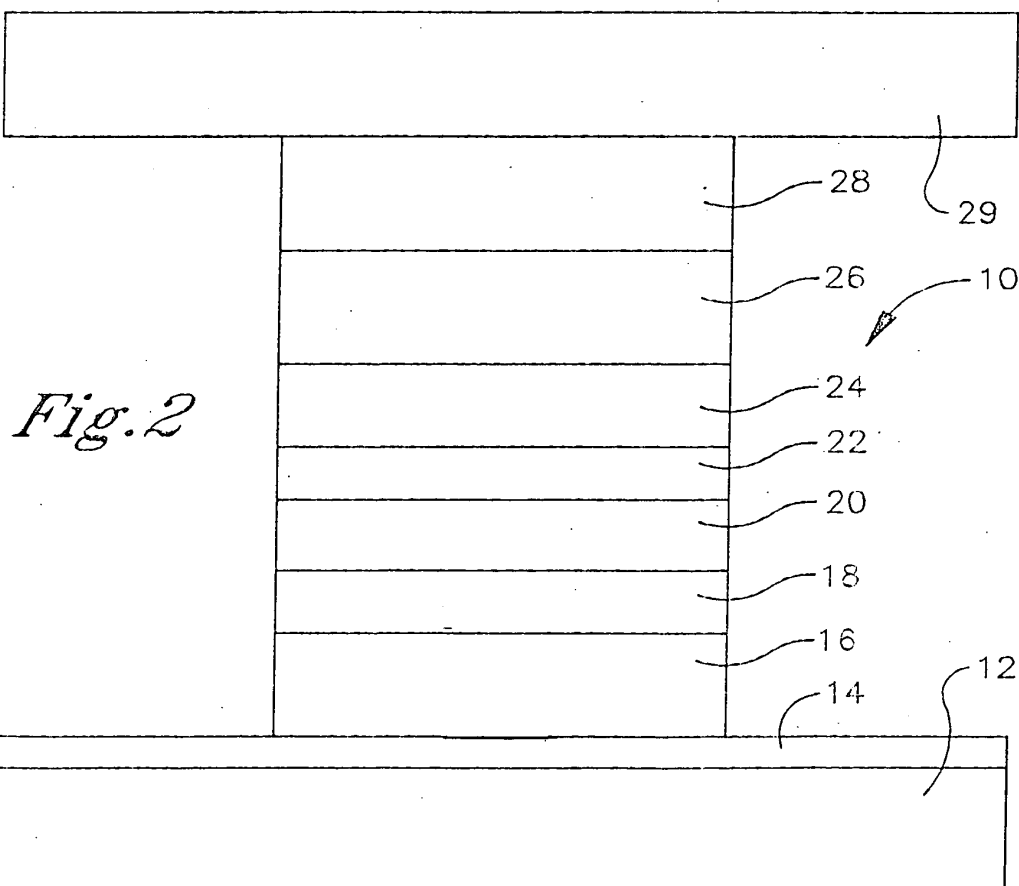
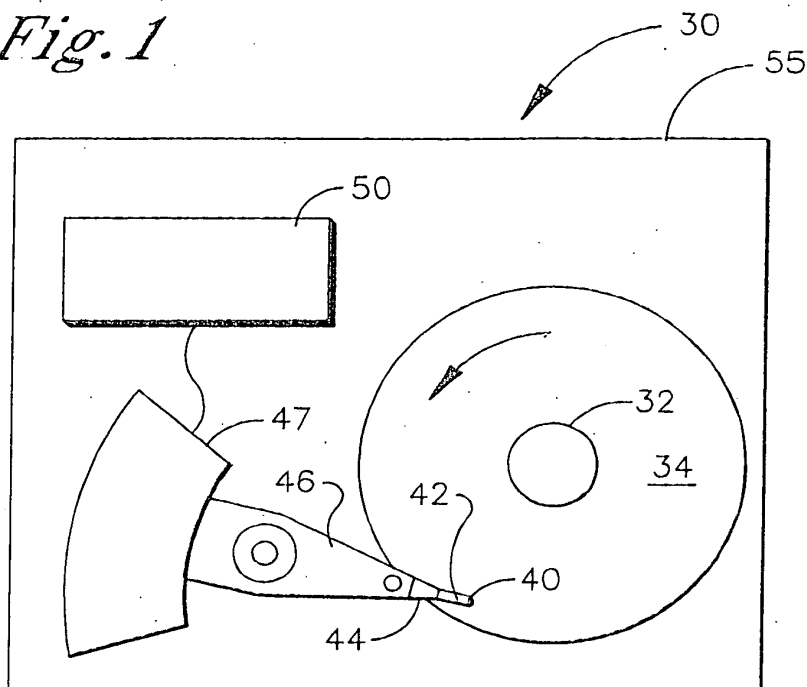


Fig. 2

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

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

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: **MAGNETIC TUNNEL TRANSISTOR WITH THIN READ GAP FOR HEAD APPLICATIONS**

the specification of which (check one)

 X is attached hereto.
 was filed on _____
 as Application Serial No. _____
 and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d) or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate or PCT International application having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
None (Number)	(Country)	(Day/Month/Year Filed)	Yes	No
_____	_____	_____	_____	_____

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56, which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

None (Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
_____	_____	_____

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

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) associated with Customer No. 36023 to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

Douglas R. Millett (#31,784)
 Duke Amaniampong (45,806)
 Patrick Duncan (#41,721)
 Darren Gold (#47,599)
 Rambod Nader (#47,262)

Michael Parker (#45,896)
 Eric Proul (#45,025)
 Matthew Zises (#47,246)
 John L. Rogitz (#33,549)

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

POWER OF ATTORNEY (Continued):

Send correspondence to attorney associated with Customer No. 24955:

John L. Rogitz (Reg.# 33,549)
Rogitz & Associates
750 B Street, Suite 3120
San Diego, California

Direct Telephone Calls to: John L. Rogitz - (619) 338-8075

INVENTORS

Full name of sole and first joint-inventor: HARDAYAL SINGH GILL

Inventor's signature:

Date:

H.S. Gill

2/6/06

Residence: 545 Lytton Avenue; Palo Alto, California 94301

Citizenship: United States of America

Post Office Address: Same

PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

02/13/2006 HMARZ11 00000024 502587 11350226

01 FC:1011	300.00 DA
02 FC:1111	500.00 DA
03 FC:1311	200.00 DA

PTO-1556
(5/87)

U.S. Government Printing Office: 2002 — 488-267/89003

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875 Effective December 8, 2004

Application or Docket Number

11350226

APPLICATION AS FILED - PART I

(Column 1)

(Column 2)

SMALL ENTITY

OR

OTHER THAN
SMALL ENTITY

FOR	NUMBER FILED	NUMBER EXTRA
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A
SEARCH FEE (37 CFR 1.16(d), (f), or (m))	N/A	N/A
EXAMINATION FEE (37 CFR 1.16(e), (p), or (u))	N/A	N/A
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).	
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))		

RATE (\$)	FEE (\$)
N/A	150.00
N/A	\$250
N/A	\$100
X\$ 25	
X100	
+180=	
TOTAL	

RATE (\$)	FEE (\$)
N/A	300.00
N/A	\$500
N/A	\$200
X\$50	
X200	
+360=	
TOTAL	1800

* If the difference in column 1 is less than zero, enter "0" in column 2.

APPLICATION AS AMENDED - PART II

(Column 1)

(Column 2)

(Column 3)

SMALL ENTITY

OR

OTHER THAN
SMALL ENTITY

AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total (37 CFR 1.16(i))	Minus	**	=
Independent (37 CFR 1.16(h))	Minus	***	=
Application Size Fee (37 CFR 1.16(s))			
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))			

RATE (\$)	ADDITIONAL FEE (\$)
X\$ 25	
X100	
+180=	
TOTAL ADD'L FEE	

RATE (\$)	ADDITIONAL FEE (\$)
X\$50	
X200	
+360=	
TOTAL ADD'L FEE	

(Column 1)

(Column 2)

(Column 3)

RATE (\$)

ADDITIONAL FEE (\$)

RATE (\$)

ADDITIONAL FEE (\$)

AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA
Total (37 CFR 1.16(i))	Minus	**	=
Independent (37 CFR 1.16(h))	Minus	***	=
Application Size Fee (37 CFR 1.16(s))			
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))			

RATE (\$)	ADDITIONAL FEE (\$)
X\$ 25	
X100	
+180=	
TOTAL ADD'L FEE	

RATE (\$)	ADDITIONAL FEE (\$)
X\$50	
X200	
+360=	
TOTAL ADD'L FEE	

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

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

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

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

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named	)	
Inventor: Gill	)	Atty. Docket#: HSJ920050318US1
	)	
Filing Date: Herewith	)	
	)	750 "B" Street, Suite 3120
For: MAGNETIC TUNNEL TRANSISTOR WITH	)	San Diego, CA 92101
THIN READ GAP FOR HEAD	)	
APPLICATIONS	)	
	)	Customer No.: 24955

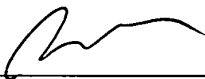
INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
Alexandria, VA 22313

Dear Sir:

Pursuant to Sections 1.97, 1.98, and 1.99 of the Rules of Practice in patent cases, enclosed is the "List of References Cited by Applicant," Form PTO-1449.

Respectfully submitted,



John L. Rogitz
Attorney of Record
Registration No. 33,549
750 "B" Street, Suite 3120
San Diego, CA 92101
Telephone: (619) 338-8075

Form PTO-1449
U.S. Department of Commerce
Patent and Trademark Office

Docket No.: HSJ920050318US1
Serial No.: Unk.
Applicant: GILL
Filing Date: Herewith

INFORMATION DISCLOSURE CITATION

U.S. PATENT DOCUMENTS

Examiner Initial	Document Number	Date	Name	Class	Sub-Class	Filing Date
	2004/0218314 A1	11/04/2004	Gill	360	324.2	
	2003/0214004 A1	11/20/2003	Sato et al.	257	427	
	2005/0226043 A1	10/13/2005	Parkin et al.	365	173	
	6,480,365 B1	11/12/2002	Gill et al.	360	324.11	
	2005/0225905 A1	10/13/005	Tera et al.	360	324.2	
	5,291,274	03/01/1994	Tamura	257	30	

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION YES OR NO

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

Examiner:

Date Considered:

Examiner: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.



020806

PTO/SB/05 (04-05)

Approved for use through 07/31/2006. OMB 0651-0032

U.S. Patent and Trademark Office. U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

UTILITY PATENT APPLICATION TRANSMITTAL <i>(Only for new nonprovisional applications under 37 CFR 1.53(b))</i>	Attorney Docket No.	HSJ920050318US1
	First Inventor	Hardayal Singh Gill
	Title	Magnetic Tunnel Transistor with ...
	Express Mail Label No.	EV568338991 US

APPLICATION ELEMENTS <i>See MPEP chapter 600 concerning utility patent application contents.</i>	ADDRESS TO: Commissioner for Patents P.O. Box 1450 Alexandria VA 22313-1450
--	---

1. ☒ **Fee Transmittal Form** (e.g., PTO/SB/17)
(Submit an original and a duplicate for fee processing)
2. ☐ **Applicant claims small entity status.**
See 37 CFR 1.27.
3. ☒ **Specification** [Total Pages 10]
Both the claims and abstract must start on a new page
(For information on the preferred arrangement, see MPEP 608.01(a))
4. ☒ **Drawing(s)** (35 U.S.C. 113) [Total Sheets 1]
5. **Oath or Declaration** [Total Sheets 2]
 a. ☒ Newly executed (original or copy)
 b. ☐ A copy from a prior application (37 CFR 1.63(d))
 (for continuation/divisional with Box 18 completed)
 i. ☐ **DELETION OF INVENTOR(S)**
 Signed statement attached deleting inventor(s)
 name in the prior application, see 37 CFR
 1.63(d)(2) and 1.33(b).
 ii. ☐ CD-ROM or CD-R (2 copies); or
 ii. ☐ Paper
 c. ☐ Statements verifying identity of above copies
6. ☐ **Application Data Sheet.** See 37 CFR 1.76
7. ☐ **CD-ROM or CD-R** in duplicate, large table or
 Computer Program (Appendix)
 ☐ Landscape Table on CD
8. **Nucleotide and/or Amino Acid Sequence Submission**
 (if applicable, items a. - c. are required)
 a. ☐ Computer Readable Form (CRF)
 b. ☐ Specification Sequence Listing on:
 i. ☐ CD-ROM or CD-R (2 copies); or
 ii. ☐ Paper
 c. ☐ Statements verifying identity of above copies

- ACCOMPANYING APPLICATION PARTS**
9. ☐ **Assignment Papers** (cover sheet & document(s))
 Name of Assignee _____
 10. ☐ **37 CFR 3.73(b) Statement** ☐ **Power of Attorney**
 (when there is an assignee)
 11. ☐ **English Translation Document** *(if applicable)*
 12. ☒ **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
 ☐ Copies of citations attached
 13. ☐ **Preliminary Amendment**
 14. ☒ **Return Receipt Postcard** (MPEP 503)
 (Should be specifically itemized)
 15. ☐ **Certified Copy of Priority Document(s)**
 (if foreign priority is claimed)
 16. ☐ **Nonpublication Request** under 35 U.S.C. 122(b)(2)(B)(i).
 Applicant must attach form PTO/SB/35 or equivalent.
 17. ☐ **Other:** _____

18. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in the first sentence of the specification following the title, or in an Application Data Sheet under 37 CFR 1.76:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: _____

Prior application information: Examiner: _____ Art Unit: _____

19. CORRESPONDENCE ADDRESS

☒ The address associated with Customer Number: 24955 OR ☐ Correspondence address below

Name				
Address				
City	State	Zip Code		
Country	Telephone	Email		

Signature		Date	February 8, 2004
Name (Print/Type)	JOHN L. ROGITZ	Registration No. (Attorney/Agent)	33,549

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.



020806

PTO/SB/17 (12-04v2)

Approved for use through 07/31/2006. OMB 0651-0032

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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Effective on 12/08/2004. Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818). FEE TRANSMITTAL For FY 2005		Complete if Known	
☐ Applicant claims small entity status. See 37 CFR 1.27		Application Number	
		Filing Date	
		First Named Inventor	
		Examiner Name	
		Art Unit	
TOTAL AMOUNT OF PAYMENT (\$)		1000	
		Attorney Docket No. HSJ920050318US1	

METHOD OF PAYMENT (check all that apply)

☐ Check
 ☐ Credit Card
 ☐ Money Order
 ☐ None
 ☐ Other (please identify): _____

☒ Deposit Account
 Deposit Account Number: 50-2587
 Deposit Account Name: Hitachi Global Storage

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☒ Charge fee(s) indicated below
 ☐ Charge fee(s) indicated below, except for the filing fee

☒ Charge any additional fee(s) or underpayments of fee(s) under 37 CFR 1.16 and 1.17
 ☒ Credit any overpayments

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

FEE CALCULATION**1. BASIC FILING, SEARCH, AND EXAMINATION FEES**

Application Type	FILING FEES		SEARCH FEES		EXAMINATION FEES		Fees Paid (\$)
	Fee (\$)	Small Entity Fee (\$)	Fee (\$)	Small Entity Fee (\$)	Fee (\$)	Small Entity Fee (\$)	
Utility	300	150	500	250	200	100	1000
Design	200	100	100	50	130	65	
Plant	200	100	300	150	160	80	
Reissue	300	150	500	250	600	300	
Provisional	200	100	0	0	0	0	

2. EXCESS CLAIM FEES

Fee Description	Fee (\$)	Small Entity Fee (\$)
Each claim over 20 (including Reissues)	50	25
Each independent claim over 3 (including Reissues)	200	100
Multiple dependent claims	360	180
Total Claims	Extra Claims	Fee (\$)
20 - 20 or HP = 0	x 50	= 0
HP = highest number of total claims paid for, if greater than 20.		
Indep. Claims	Extra Claims	Fee (\$)
3 - 3 or HP = 0	x 200	= 0
HP = highest number of independent claims paid for, if greater than 3.		
		Multiple Dependent Claims
		Fee (\$)
		Fee Paid (\$)

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee (\$)	Fee Paid (\$)
- 100 =	/ 50 =	(round up to a whole number) x		

4. OTHER FEE(S)

Non-English Specification, \$130 fee (no small entity discount)

Other (e.g., late filing surcharge):

Fees Paid (\$)

SUBMITTED BY		
Signature		Registration No. 33,549
Name (Print/Type)	JOHN L. ROGITZ	Telephone 619.338.8075
		Date February 8, 2004

This collection of information is required by 37 CFR 1.136. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

RECEIVED
CENTRAL FAX CENTER

Applicant:	Hardayal Singh Gill	)	Art Unit:	2652
Serial No.:	11/350,226	)	Examiner:	Unk.
Filed:	February 8, 2006	)	CASE NO.:	HSJ920050318US1
For:	Magnetic Tunnel Transistor with Thin Read Gap	)	March 13, 2006	
for Head Applications		)	750 B Street, Suite 3120	
		)	San Diego, CA 92101	

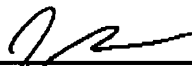
MAR 13 2006

TRANSMITTAL LETTER FOR- CORRECTION OF ERROR IN FILING RECEIPTCommissioner for Patents
Alexandria, VA 22313

Dear Sir:

The Filing Receipt for the above-captioned patent application lists the applicant's city as Palo Alton. This is incorrect. Please update the Filing Receipt to show the applicant's city as Palo Alto. A copy of the incorrect Filing Receipt is transmitted herewith.

Respectfully submitted,

John L. Rogitz, Attorney of Record
Registration No. 33,549
750 "B" Street, Suite 3120
San Diego, CA 92101
Telephone: (619) 338-8075

Encs.

We are transmitting a total of 4 page(s) including this cover sheet.IF YOU DO NOT RECEIVE ALL TRANSMITTED PAGES, PLEASE CALL US AT:
619/338-8075

ORIGINAL DOCUMENTS WILL BE SENT VIA:

() U.S. MAIL	() FEDERAL EXPRESS	() MESSENGER	(X) WILL NOT BE SENT
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FROM ROGITZ 619-338-8078

RECEIVED
(MON) MAR 13 2006 13:41/No. 6833031901 P 2
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MAR 13 2006

1189.063



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www.uspto.gov

APPL NO.	FILING OR 371 (c) DATE	ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	DRAWINGS	TOT CLMS	IND CLMS
11/350,226	02/08/2006	2652	1000	HSJ920050318US1	1	20	3

24955
ROGITZ & ASSOCIATES
760 B STREET
SUITE 3120
SAN DIEGO, CA 92101

CONFIRMATION NO. 9816

FILING RECEIPT



OC000000018225123

Date Mailed: 03/08/2006

Receipt is acknowledged of this regular Patent Application. It will be considered in its order and you will be notified as to the results of the examination. Be sure to provide the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please mail to the Commissioner for Patents P.O. Box 1450 Alexandria Va 22313-1450. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections (if appropriate).

Applicant(s)

Hardayal Singh Gill, Palo Alto, CA;

Power of Attorney: The patent practitioners associated with Customer Number 36023.

Domestic Priority data as claimed by applicant

Foreign Applications

If Required, Foreign Filing License Granted: 03/07/2006

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US11/350,226**

Projected Publication Date: 08/09/2007

Non-Publication Request: No

Early Publication Request: No

Title

Magnetic tunnel transistor with thin read gap for head applications

Preliminary Class

360

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process simplifies the filing of patent applications on the same invention in member countries, but does not result in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER Title 35, United States Code, Section 184 Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).



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APPLICATION NUMBER	FILING OR 371(c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
11/350,226	02/08/2006	Hardayal Singh Gill	HSJ920050318US1

CONFIRMATION NO. 9816

24955
ROGITZ & ASSOCIATES
750 B STREET
SUITE 3120
SAN DIEGO, CA92101

Title: Magnetic tunnel transistor with thin read gap for head applications

Publication No. US-2007-0183100-A1

Publication Date: 08/09/2007

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publicly available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently <http://www.uspto.gov/patft/>.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently <http://pair.uspto.gov/>. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Pre-Grant Publication Division, 703-605-4283



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/350,226	02/08/2006	Hardayal Singh Gill	HSJ920050318US1	9816
24955 7590 03/19/2009 ROGITZ & ASSOCIATES 750 B STREET SUITE 3120 SAN DIEGO, CA 92101			EXAMINER RENNER, CRAIG A	
			ART UNIT 2627	PAPER NUMBER
			MAIL DATE 03/19/2009	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.		Applicant(s)	
	11/350,226		GILL, HARDAYAL SINGH	
	Examiner		Art Unit	
	Craig A. Renner		2627	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 1 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☐ Responsive to communication(s) filed on ____.

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) 1-20 is/are pending in the application.

4a) Of the above claim(s) ____ is/are withdrawn from consideration.

5) ☐ Claim(s) ____ is/are allowed.

6) ☐ Claim(s) ____ is/are rejected.

7) ☐ Claim(s) ____ is/are objected to.

8) ☒ Claim(s) 1-20 are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☐ All b) ☐ Some * c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. ____.

3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892) 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.	4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____. 5) ☐ Notice of Informal Patent Application 6) ☐ Other: _____.
---	--

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
 - I. Claims 1-15, drawn to a "magnetic tunnel transistor," classified in class 257, subclass 30.
 - II. Claims 16-20, drawn to a "read head," classified in class 360, subclass 324.2.
2. The inventions are distinct, each from the other because of the following reasons:

Inventions of groups II and I are related as combination and subcombination, respectively. Inventions in this relationship are distinct if it can be shown that (1) the combination as claimed does not require the particulars of the subcombination as claimed for patentability, and (2) that the subcombination has utility by itself or in other combinations (MPEP § 806.05(c)). In the instant case, the combination as claimed does not require the particulars of the subcombination as claimed because the combination does not require for "a barrier layer of MgO disposed between the base and the emitter structure," "wherein the emitter structure is pinned by a pinning layer," or "a barrier height of less than three-tenths of an electron volt," for instance. The subcombination has separate utility such as usable in a memory as opposed to a read head.

The examiner has required restriction between combination and subcombination inventions. Where applicant elects a subcombination, and claims thereto are subsequently found allowable, any claim(s) depending from or otherwise requiring all the limitations of the allowable subcombination will be examined for patentability in

accordance with 37 CFR 1.104. See MPEP § 821.04(a). Applicant is advised that if any claim presented in a continuation or divisional application is anticipated by, or includes all the limitations of, a claim that is allowable in the present application, such claim may be subject to provisional statutory and/or nonstatutory double patenting rejections over the claims of the instant application.

3. Restriction for examination purposes as indicated is proper because all these inventions listed in this action are independent or distinct for the reasons given above and there would be a serious search and examination burden if restriction were not required because one or more of the following reasons apply:

- (a) the inventions have acquired a separate status in the art in view of their different classification;
- (b) the inventions have acquired a separate status in the art due to their recognized divergent subject matter;
- (c) the inventions require a different field of search (for example, searching different classes/subclasses or electronic resources, or employing different search queries);
- (d) the prior art applicable to one invention would not likely be applicable to another invention;
- (e) the inventions are likely to raise different non-prior art issues under 35 U.S.C. 101 and/or 35 U.S.C. 112, first paragraph.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a invention to be examined even though the requirement may be traversed (37 CFR 1.143) and (ii) identification of the claims encompassing the elected invention.

The election of an invention may be made with or without traverse. To reserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the restriction requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected invention.

If claims are added after the election, applicant must indicate which of these claims are readable upon the elected invention.

Should applicant traverse on the ground that the inventions are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the inventions to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the inventions unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other invention.

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Craig A. Renner whose telephone number is (571) 272-7580. The examiner can normally be reached on Tuesday-Friday 9:00 AM - 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, A. L. Wellington can be reached on (571) 272-4483. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Craig A. Renner/
Primary Examiner, Art Unit 2627

CAR



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 Alexandria, Virginia 22313-1450
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BIB DATA SHEET

CONFIRMATION NO. 9816

SERIAL NUMBER 11/350,226	FILING or 371(c) DATE 02/08/2006 RULE	CLASS 360	GROUP ART UNIT 2627	ATTORNEY DOCKET NO. HSJ920050318US1		
APPLICANTS Hardayal Singh Gill, Palo Alto, CA; ** CONTINUING DATA ***** ** FOREIGN APPLICATIONS ***** ** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 03/07/2006						
Foreign Priority claimed ☐ Yes ☒ No 35 USC 119(a-d) conditions met ☐ Yes ☒ No Verified and Acknowledged <u>/CRAIG A RENNER/</u> Examiner's Signature		☐ Met after Allowance Initials	STATE OR COUNTRY CA	SHEETS DRAWINGS 1	TOTAL CLAIMS 20	INDEPENDENT CLAIMS 3
ADDRESS ROGITZ & ASSOCIATES 750 B STREET SUITE 3120 SAN DIEGO, CA 92101 UNITED STATES						
TITLE Magnetic tunnel transistor with thin read gap for head applications						
FILING FEE RECEIVED 1000	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:		☐ All Fees			
			☐ 1.16 Fees (Filing)			
			☐ 1.17 Fees (Processing Ext. of time)			
			☐ 1.18 Fees (Issue)			
			☐ Other _____			
			☐ Credit			

**RECEIVED
CENTRAL FAX CENTER****MAR 23 2009****IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

First Named Applicant: Gill	)	Art Unit: 2627
	)	
Serial No.: 11/350,226	)	Examiner: Renner
	)	
Filed: February 8, 2006	)	HSJ920050318US1
	)	
For: MAGNETIC TUNNEL TRANSISTOR WITH THIN	)	March 21, 2009
READ GAP FOR HEAD APPLICATIONS	)	750 B STREET, Suite 3120
	)	San Diego, CA 92101
	)	

RESPONSE TO OFFICE ACTION

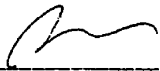
Commissioner for Patents
Alexandria, VA

Dear Sir:

This responds to the Office Action dated March 19, 2009. Applicant elects Claims 1-15.

The Examiner is cordially invited to telephone the undersigned at (619) 338-8075 for any reason which would advance the instant application to allowance.

Respectfully submitted,



John L. Rogitz
Registration No. 33,549
Attorney of Record
750 B Street, Suite 3120
San Diego, CA 92101
Telephone: (619) 338-8075

JLR:jg

1189-63.AMD



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/350,226	02/08/2006	Hardayal Singh Gill	HSJ920050318US1	9816
24955 7590 06/10/2009 ROGITZ & ASSOCIATES 750 B STREET SUITE 3120 SAN DIEGO, CA 92101			EXAMINER DIAZ, JOSE R	
			ART UNIT 2815	PAPER NUMBER
			MAIL DATE 06/10/2009	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.		Applicant(s)	
	11/350,226		GILL, HARDAYAL SINGH	
	Examiner		Art Unit	
	JOSE R. DIAZ		2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on 23 March 2009.

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) 1-20 is/are pending in the application.

4a) Of the above claim(s) 16-20 is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) 1-15 is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☒ The drawing(s) filed on 08 February 2009 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☐ All b) ☐ Some * c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. _____.

3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date 2/8/06.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election of claims 1-15 in the reply filed on March 23, 2009 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)).

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by Childress et al. (US 7,259,942 B2).

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in

the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

Regarding claim 1, Childress discloses a magnetic tunnel transistor (MTT) comprising:

- a ferromagnetic base (Base Region 704) [Fig. 7];
- a ferromagnetic emitter structure (Emitter Region 702) [Fig. 7 and col. 8, lines 9-11]; and
- a ferromagnetic collector that does not include GaAs [Fig. 7 and col. 8, lines 12-14].

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 2-4 and 8-12 are rejected under 35 U.S.C. 103(a) as being obvious over Childress et al. (US 7,259,942 B2) in view of Shimazawa et al. (US 6,671,141 B2).

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art only under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 103(a) might be overcome by: (1) a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not an

invention “by another”; (2) a showing of a date of invention for the claimed subject matter of the application which corresponds to subject matter disclosed but not claimed in the reference, prior to the effective U.S. filing date of the reference under 37 CFR 1.131; or (3) an oath or declaration under 37 CFR 1.130 stating that the application and reference are currently owned by the same party and that the inventor named in the application is the prior inventor under 35 U.S.C. 104, together with a terminal disclaimer in accordance with 37 CFR 1.321(c). This rejection might also be overcome by showing that the reference is disqualified under 35 U.S.C. 103(c) as prior art in a rejection under 35 U.S.C. 103(a). See MPEP § 706.02(I)(1) and § 706.02(I)(2).

Regarding claims 2-3, 8-9 and 11, Childress substantially discloses the claimed invention including a first barrier layer (710) disposed between the collector and the base; and a second barrier layer (708) disposed between the base and the emitter [Fig. 7]. With regards to the claimed materials, Childress discloses that the barrier layers (710/708) may be formed of a tunnel barrier material [Col. 8, lines 5-10].

However, Childress is silent with respect to TiO and MgO as the tunnel barrier materials.

Shimazawa teaches that TiO and MgO are very well known tunnel barrier materials [col. 8, lines 54-56].

Childress and Shimazawa are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to use TiO as the first barrier layer between the collector and the base of the device taught by Childress; and MgO as the

Art Unit: 2815

second barrier layer between the base and the emitter of the device taught by Childress. The motivation for doing so, as is taught by Shimazawa, is to reduce resistance (col. 8, line 57). In addition, it would have been obvious to combine the references since the substitution of one known element for another yields predictable results to one of ordinary skill in the art. Therefore, it would have been obvious to combine Shimazawa with Childress to obtain the invention of claims 2-3.

Regarding claims 4 and 12, Childress discloses wherein the collector is made of NiFe and/or CoFe [col. 8, lines 12-14].

Regarding claim 10, Childress discloses a ferromagnetic collector that does not include GaAs [Fig. 7 and col. 8, lines 12-14].

6. Claims 5-7 and 13-15 are rejected under 35 U.S.C. 103(a) as being obvious over Childress et al. (US 7,259,942 B2) in view of Shimazawa et al. (US 6,671,141 B2), and further in view of Sato et al. (US 2006/0256484 A1).

Regarding claims 5-7 and 13-15, Childress discloses collector (906), first tunnel barrier (926), Base region (904), second tunnel barrier (920), Emitter region (902) and pinning layer (918) [Fig. 9]. Furthermore, Shimazawa teaches TiO and MgO as well known tunnel barriers [col. 8, lines 54-56].

The combination of prior art references substantially teaches the claimed invention except for a base made of CoFeB.

Sato teaches a CoFeB/MgO/CoFeB/Ru/CoFe (13-18) [paragraphs 0053, 0054, 0056, 0062, 0066, 0069, 0072].

Childress, Shimazawa and Sato are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include a base made of CoFeB in the device taught by Childress. The motivation for further doing so, as is taught by Sato is to improve the quality of the tunnel barrier film (paragraph 0066). In addition, it would have been obvious to combines the references since the substitution of one known element for another yields predictable results to one of ordinary skill in the art. Therefore, it would have been 5-7 and 13-15.

Double Patenting

7. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Art Unit: 2815

8. Claims 1-15 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-10 of U.S. Patent No. 7,259,942 B2 in view of Shimazawa et al. (US 6,671,141 B2), and further in view of Sato et al. (US 2006/0256484 A1). Claims 1-15 claim a device which is similar in scope as the one recited in claims 1-10 of the '942 patent. See rejections above for teachings of the secondary references to Shimazawa and Sato.

Correspondence

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOSE R. DIAZ whose telephone number is (571)272-1727. The examiner can normally be reached on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2815

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Kenneth A Parker/
Supervisory Patent Examiner, Art Unit 2815

/J. R. D./
Examiner, Art Unit 2815

Notice of References Cited	Application/Control No. 11/350,226	Applicant(s)/Patent Under Reexamination GILL, HARDAYAL SINGH	
	Examiner JOSE R. DIAZ	Art Unit 2815	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-7,259,942	08-2007	Childress et al.	360/324.12
*	B	US-2006/0256484	11-2006	Sato et al.	360/324.2
*	C	US-6,671,141	12-2003	Shimazawa et al.	360/324.2
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

<i>Index of Claims</i> 	Application/Control No. 11350226	Applicant(s)/Patent Under Reexamination GILL, HARDAYAL SINGH
	Examiner JOSE R DIAZ	Art Unit 2815

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant
 ☐ CPA
 ☐ T.D.
 ☐ R.1.47

CLAIM		DATE								
Final	Original	06/08/2009								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
	11	✓								
	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	N								
	17	N								
	18	N								
	19	N								
	20	N								

Search Notes 	Application/Control No. 11350226	Applicant(s)/Patent Under Reexamination GILL, HARDAYAL SINGH
	Examiner JOSE R DIAZ	Art Unit 2815

SEARCHED			
Class	Subclass	Date	Examiner
257	29,E21.208	6/8/09	JRD

SEARCH NOTES		
Search Notes	Date	Examiner
Text Search EAs. See search history printout. 257/295; 360/324.2	6/08/09	JRD

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

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EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	6	US-20040218314-\$.DID. OR US-6480365-\$.DID. OR US- 20050225905-\$.DID.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2009/06/08 04:14
S1	2	("20070183100").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/04/24 10:37
S2	110	(257/29).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/04/24 11:37
S3	23463	mtt or (magnetic near tunel \$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/04/24 11:39
S4	371	emitter and base and collector and S3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/04/24 11:40
S5	2	("7372674").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/04/24 11:45
S6	0	("2008/0007876").URPN.	USPAT	OR	ON	2009/04/24 11:54
S7	0	(11/900537).APP.	USPAT; USOCR	OR	ON	2009/04/24 11:54
S8	442	base near5 (nife or cofe)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/04/24 12:03

S9	5	collector near5 (nife or cofe)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/04/24 12:04
S10	47	base near5 (cofeb or (co near1 fe near1 b))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/04/24 12:05
S11	1	S9 and S10	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/04/24 12:05
S12	3	(magnetic near tunel\$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/04/24 12:37
S13	6325	(magnetic near tunnel\$3)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/04/24 12:37
S14	799	(tio or mgo) and S13	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/04/24 12:38
S15	465	(ru or ruthenium) and S14	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/04/24 12:40
S16	2706	(257/295).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/06/07 07:37
S17	336	(257/E21.208).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/06/07 07:37

S18	2	("7368301").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/06/07 07:41
S19	20840	(magnetic or ferromagnetic) and pinn\$3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 08:01
S20	216727	(magnetic or ferromagnetic) and (pin or pinning or pinned or pined)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 08:02
S21	22738	S20 and barrier	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 08:02
S22	4210	S21 and (cobalt or cofeb or (co near1 fe near1 b))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 08:03
S23	397	S22 and collector	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 08:03
S24	327	S22 and emitter	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 08:04
S25	179	S23 and S24	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 08:04
S26	8	((("5,390,061") or ("5,650,958") or ("5,729,410") or ("5,764,567")).PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/06/07 08:06

S27	2357	S22 and head	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 08:11
S28	2	("20070139827").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/06/07 08:18
S29	2	("7,149,105").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/06/07 08:29
S30	10	("20030072109" "5650958" "5841692" "6181537" "6452240" "6518588" "6707084" "6842317").PN. OR ("7149105").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2009/06/07 08:34
S31	768	(360/324.2).OCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/06/07 08:44
S32	5570	S21 and (cobalt or cofeb or (co near1 fe near1 b) or cofe or (co near1 fe))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 08:46
S33	636	S31 and (cobalt or cofeb or (co near1 fe near1 b) or cofe or (co near1 fe))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 08:46
S34	95	S33 and ((magnesium near oxide) or (Mg near1 O))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 08:48
S35	0	(12/100097).APP.	USPAT; USOCR	OR	ON	2009/06/07 08:49
S36	6	US-6347049-\$.DID. OR US- 20040109347-\$.DID. OR US- 6841395-\$.DID.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2009/06/07 08:51

S37	6	US-6347049-\$.DID. OR US-20040109347-\$.DID. OR US-6841395-\$.DID.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2009/06/07 08:51
S38	6	US-6347049-\$.DID. OR US-20040109347-\$.DID. OR US-6841395-\$.DID.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2009/06/07 08:51
S39	2	("7372674").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/06/07 08:59
S40	156	collector near1 ((ni ner1 fe) or (co near fe))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 09:00
S41	27	((magnetic or ferromagnetic) or head) and S40	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 09:01
S42	491	(gill near1 hardayal).in.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 09:05
S43	0	(11/863131).APP.	USPAT; USOCR	OR	ON	2009/06/07 09:23
S44	0	(11/379162).APP.	USPAT; USOCR	OR	ON	2009/06/07 09:38
S45	1	(10/627293).APP.	USPAT; USOCR	OR	ON	2009/06/07 10:25
S46	11	("20020024780" "20020181169" "20030214004" "20040061984" "20040257192" "6295187" "6400536" "6480365" "6501143" "6655006").PN. OR ("7084467").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2009/06/07 10:25

S47	22	("20030122208" "20030164509" "20030214004" "20030214763" "20030235016" "20040008454" "5416353" "5432373" "5747859" "6023395" "6201259" "6438026" "6473279" "6480365" "6501143" "6577476" "6680832" "6704175" "6724586" "6741432" "7084467").PN. OR ("7259942").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2009/06/07 10:44
S48	4155	tunnel adj barrier	US-PGPUB; USPAT; USOCR	OR	ON	2009/06/07 11:24
S49	3267	S48 and (@ad<"20060208" or @ad<"20060208")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 11:25
S50	3570	S48 and (@ad<"20060208" or @rlad<"20060208")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 11:25
S51	333	tio near2 mgo	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 11:26
S52	2	S50 and S51	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 11:26
S53	28	(tunnel adj barrier) near5 (tio or (ti near o) or "tio.sub.2" or (titanium adj oxide))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 11:28
S54	262	(tunnel adj barrier) near5 (Mgo or (Mg near o) or (magnesium adj oxide))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 11:29

S55	284	S53 S54	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 11:29
S56	6	S53 and S54	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 11:29
S57	19	S53 and (@ad<"20060208" or @rlad<"20060208")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 11:31
S58	133	S54 and (@ad<"20060208" or @rlad<"20060208")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 11:31
S59	7803	(international near business near machines).as. and (mtt or (magnetic near tunnel\$3) or ((magnetic or ferromagnetic) and (pin or pinned or pinning or head)))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 21:17
S60	883	S59 and (cobalt or cofeb or (co near1 fe near1 b) or cofe or (co near1 fe))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 21:17
S61	82	(tio or mgo) and S60	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 21:18
S62	1	(11/452741).APP.	USPAT; USOCR	OR	ON	2009/06/07 21:21
S63	6	("20020085321" "20040041183" "20060054947" "20060056115" "20060262594" "6545906"). PN. OR ("7535069").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2009/06/07 21:24

S64	4897	(hitachi near global near storage).as. and (mtt or (magnetic near tunnel\$3) or ((magnetic or ferromagnetic) and (pin or pinnned or pinning or head)))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 21:41
S65	1102	S64 and (cobalt or cofeb or (co near1 fe near1 b) or cofe or (co near1 fe))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 21:42
S66	1	(tio and mgo) and S65	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 21:42
S67	19	S65 and collector	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/06/07 21:45

6/ 8/ 09 4:15:48 AM

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Receipt date: 02/08/2006

11350226 - GAU: 2815

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named	)	
Inventor: Gill	)	Atty. Docket#: HSJ920050318US1
	)	
Filing Date: Herewith	)	
	)	750 "B" Street, Suite 3120
For: MAGNETIC TUNNEL TRANSISTOR WITH	)	San Diego, CA 92101
THIN READ GAP FOR HEAD	)	
APPLICATIONS	)	
	)	Customer No.: 24955

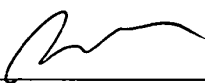
INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
Alexandria, VA 22313

Dear Sir:

Pursuant to Sections 1.97, 1.98, and 1.99 of the Rules of Practice in patent cases, enclosed is the "List of References Cited by Applicant," Form PTO-1449.

Respectfully submitted,



John L. Rogitz
Attorney of Record
Registration No. 33,549
750 "B" Street, Suite 3120
San Diego, CA 92101
Telephone: (619) 338-8075

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /JRD/

Receipt date: 02/08/2006

11350226 - GAU: 2815

Page 1 of 1

Form PTO-1449
U.S. Department of Commerce
Patent and Trademark Office

Docket No.: HSJ920050318US1
Serial No.: Unk.
Applicant: GILL
Filing Date: Herewith

INFORMATION DISCLOSURE CITATION

U.S. PATENT DOCUMENTS

Examiner Initial	Document Number	Date	Name	Class	Sub-Class	Filing Date
	2004/0218314 A1	11/04/2004	Gill	360	324.2	
	2003/0214004 A1	11/20/2003	Sato et al.	257	427	
	2005/0226043 A1	10/13/2005	Parkin et al.	365	173	
	6,480,365 B1	11/12/2002	Gill et al.	360	324.11	
	2005/0225905 A1	10/13/005	Tera et al.	360	324.2	
	5,291,274	03/01/1994	Tamura	257	30	

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION YES OR NO

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

Examiner: /Jose R Diaz/	Date Considered: 06/08/2009
-------------------------	-----------------------------

Examiner: Initial if citation considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /JRD/

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JUN 16 2009

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Applicant: Gill	)	Art Unit: 2815
	)	
Serial No.: 11/350,226	)	Examiner: Diaz
	)	
Filed: February 8, 2006	)	HSJ920050318US1
	)	
For: MAGNETIC TUNNEL TRANSISTOR WITH THIN	)	June 16, 2009
READ GAP FOR HEAD APPLICATIONS	)	750 B STREET, Suite 3120
	)	San Diego, CA 92101
	)	

RESPONSE TO OFFICE ACTION

Commissioner for Patents
Alexandria, VA

Dear Sir:

This responds to the Office Action dated June 10, 2009.

1189-63.AM1

CASE NO.: HSJ920050318US1
Serial No.: 11/350,226
June 16, 2009
Page 2

PATENT
Filed: February 8, 2006

1 (canceled).

2. (currently amended) ~~The MTT of Claim 1, comprising~~ A magnetic tunnel transistor (MTT) comprising:

a ferromagnetic base;

a ferromagnetic emitter structure;

a ferromagnetic collector that does not include GaAs; and

a barrier layer of TiO disposed between the collector and the base.

3. (original) The MTT of Claim 2, comprising a barrier layer of MgO disposed between the base and the emitter structure.

4. (original) The MTT of Claim 2, wherein the collector is made of NiFe and/or CoFe.

5. (original) The MTT of Claim 2, wherein the base is made of CoFeB.

6. (original) The MTT of Claim 2, wherein the emitter structure includes a layer of Ru disposed between a layer of CoFeB and a layer of CoFe.

7. (original) The MTT of Claim 6, wherein the emitter structure is pinned by a pinning layer.

1189-63.AM1

CASE NO.: HSJ920050318US1
Serial No.: 11/350,226
June 16, 2009
Page 3

PATENT
Filed: February 8, 2006

8. (original) A magnetic tunnel transistor (MTT) comprising:
- a ferromagnetic base;
 - a ferromagnetic emitter structure;
 - a ferromagnetic collector; and
 - a barrier layer between the collector and base and having a barrier height of less than three-tenths of an electron volt.
9. (original) The MTT of Claim 8, wherein the barrier layer is made of TiO.
10. (original) The MTT of Claim 9, wherein the collector does not include GaAs.
11. (original) The MTT of Claim 9, comprising a barrier layer of MgO disposed between the base and the emitter structure.
12. (original) The MTT of Claim 9, wherein the collector is made of NiFe and/or CoFe.
13. (original) The MTT of Claim 9, wherein the base is made of CoFeB.

1189-63.AM1

CASE NO.: HSJ920050318US1
Serial No.: 11/350,226
June 16, 2009
Page 4

PATENT
Filed: February 8, 2006

14. (original) The MTT of Claim 9, wherein the emitter structure includes a layer of Ru disposed between a layer of CoFeB and a layer of CoFe.

15. (original) The MTT of Claim 14, wherein the emitter structure is pinned by a pinning layer.

16. (withdrawn) A read head for a disk drive, comprising:

a magnetic tunnel transistor (MTT) including a barrier of TiO disposed between a ferromagnetic collector and a ferromagnetic base.

17. (withdrawn) The read head of Claim 16, in combination with a disk drive.

18. (withdrawn) The read head of Claim 16, comprising an emitter structure separated from the base by a barrier.

19. (withdrawn) The read head of Claim 16, wherein the collector does not include GaAs.

20. (withdrawn) The read head of Claim 18, wherein the collector is made of NiFe and/or CoFe, the base is made of CoFeB, and the emitter structure includes a layer of Ru disposed between a layer of CoFeB and a layer of CoFe.

1189-63.AM1

CASE NO.: HSJ920050318US1
Serial No.: 11/350,226
June 16, 2009
Page 5

PATENT
Filed: February 8, 2006

Remarks

Reconsideration of the application is requested. Claim 1 has been rejected under 35 U.S.C. §102 as being anticipated by Childress, USPN 7,259,942, and Claims 2-4 and 8-12 have been rejected under 35 U.S.C. §103 as being unpatentable over Childress in view of Shimazawa, USPN 6,671,141. Claims 5-7 and 13-15 have been rejected under 35 U.S.C. §103 as being unpatentable over Childress in view of Shimazawa and Sato, USPP 2006/0256484.

Claim 2 has been rewritten in independent form. At the time the present invention was made, both it and Childress were commonly owned by Hitachi Global Storage Technologies Netherlands B.V. Claims 1-14 are now patentable.

Furthermore, the barrier height explicitly recited in Claim 8 has not been mentioned in the rejection much less identified in the references. Note that not all TiO barriers inherently have the recited height, cast in terms of electron volts. The rejection of Claim 8 has been further overcome.

All elected claims have been rejected for obviousness-type double patenting over Childress in view of Shimizawa and Sato based on the allegation that the claims recite "a device that is similar in scope as the one recited in claims 1-10" of Childress, without further analysis. Applicant disagrees with the examiner's stated basis for this rejection. Claim 1 of Childress is not "similar in scope" to present Claim 2, for example, since claim 1 of Childress requires a plethora of limitations, including a barrier between the emitter and base, a free layer in the base, a pinned layer in the base, a spacer layer in the base, and a longitudinal biasing layer that are nowhere in present Claim 2. Similarly, present Claim 2 requires elements not explicated in claim 1 of Childress, including, for example, that the emitter and base are

1189-63.AM1

CASE NO.: HSJ920050318US1
Serial No.: 11/350,226
June 16, 2009
Page 6

PATENT
Filed: February 8, 2006

ferromagnetic and that the collector must not include GaAs. Accordingly, because the examiner's stated basis for this rejection appears to be incorrect, Applicant asserts that the rejection is overcome.

In addition, the prior examiner made a finding of fact on the written record that the elected claims were patentably distinct from the non-elected claims because the elected claims have "separate utility such as usable in a memory as opposed to a read head". However, the present examiner's use of Childress and Sato in the present rejection diametrically contradicts the basis for the restriction, see, e.g., the title of Sato and the first sentence of the abstract of Childress (both of which make clear that the references are drawn to magnetic heads, which the prior examiner explicitly found to be patentably distinct from the elected claims). Accordingly, it is respectfully submitted that for consistency, the restriction requirement be withdrawn and the non-elected claims be rejoined and allowed.

The Examiner is cordially invited to telephone the undersigned at (619) 338-8075 for any reason which would advance the instant application to allowance.

Respectfully submitted,



John L. Rogitz
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Telephone: (619) 338-8075

JLR:jg

1189-63.AM1

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875					Application or Docket Number 11/350,226		Filing Date 02/08/2006		☐ To be Mailed	
APPLICATION AS FILED – PART I										
(Column 1)			(Column 2)			SMALL ENTITY ☐ OR		OTHER THAN SMALL ENTITY		
FOR	NUMBER FILED	NUMBER EXTRA	RATE (\$)	FEE (\$)		RATE (\$)	FEE (\$)			
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A				
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A				
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A				
TOTAL CLAIMS (37 CFR 1.16(l))	minus 20 =	*	X \$ =		OR	X \$ =				
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X \$ =			X \$ =				
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).									
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))										
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL				
APPLICATION AS AMENDED – PART II										
(Column 1)			(Column 2)			SMALL ENTITY OR		OTHER THAN SMALL ENTITY		
AMENDMENT	06/16/2009	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)		RATE (\$)	ADDITIONAL FEE (\$)
	Total (37 CFR 1.16(i))	* 19	Minus	** 20	=	X \$ =		OR	X \$ =	
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	=	X \$ =		OR	X \$ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)		RATE (\$)	ADDITIONAL FEE (\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X \$ =		OR	X \$ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X \$ =		OR	X \$ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.										

Legal Instrument Examiner:
/PEGGY YARBOROUGH/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/350,226	02/08/2006	Hardayal Singh Gill	HSJ920050318US1	9816
24955 7590 10/15/2009 ROGITZ & ASSOCIATES 750 B STREET SUITE 3120 SAN DIEGO, CA 92101			EXAMINER DIAZ, JOSE R	
			ART UNIT 2815	PAPER NUMBER
			MAIL DATE 10/15/2009	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	11/350,226	GILL, HARDAYAL SINGH	
	Examiner	Art Unit	
	JOSE R. DIAZ	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on 16 June 2009.

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) 2-20 is/are pending in the application.

 4a) Of the above claim(s) 16-20 is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) 2-15 is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☐ All b) ☐ Some * c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. _____.

3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
 Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413)
 Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 2-4 and 8-12 are rejected under 35 U.S.C. 103(a) as being obvious over Nowak et al. (US 7,453,084 B2) in view of Lee et al. ("Large Magnetocurrents in Double-barrier Tunneling Transistors", Journal of Magnetism and Magnetic Materials, Feb. 2005, vol. 286, p.138-41).

Regarding claims 2 and 8-10, Nowak discloses a magnetic tunnel transistor (MTT) comprising:

a base (16) [Fig. 1];

a ferromagnetic emitter structure (12) [Fig. 1 and col. 3, lines 35-36]; and

a collector (20) that does not include GaAs [Fig. 1 and col. 5, lines 7-9].

a barrier layer of TiO (18) disposed between the collector and the base, having a barrier height of less than three-tenths of an electron volt [Fig. 1 and col. 3, lines 65-67 and col. 4, lines 21-22 and 25-27].

Nowak substantially discloses the claimed invention except for a ferromagnetic base and a ferromagnetic collector.

Lee teaches a MTT structure comprising a ferromagnetic emitter, a ferromagnetic base and a ferromagnetic collector [abstract].

Regarding claims 4 and 12, Lee teaches a collector made of NiFe and/or CoFe [Fig. 1 and Section 3, first paragraph].

Nowak and Lee are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include ferromagnetic layers serving as the emitter, base and collector in the device as taught by Nowak. The motivation for doing so, as is taught by Lee, is increase the collector current density (abstract). In addition, the court has held that it is within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416 (CCPA 1960); *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). Therefore, it would have been obvious to combine Lee with Nowak to obtain the invention of claims 2, 4, 8-10 and 12.

Regarding claims 3 and 11, Nowak teaches a barrier layer (14) made of a metal oxide [Fig. 1 and col. 31-33].

3. Claims 5-7 and 13-15 are rejected under 35 U.S.C. 103(a) as being obvious over Nowak et al. (US 7,453,084 B2) in view of Lee et al. ("Large Magnetocurrents in Double-barrier Tunneling Transistors", *Journal of Magnetism and Magnetic Materials*, Feb. 2005, vol. 286, p.138-41), and further in view of Sato et al. (US 2006/0256484 A1).

Regarding claims 5-7 and 13-15, the combination of prior art references substantially teaches the claimed invention except for a base made of CoFeB.

Sato teaches a CoFeB/MgO/CoFeB/Ru/CoFe (13-18) [paragraphs 0053, 0054, 0056, 0062, 0066, 0069, 0072].

Nowak, Lee and Sato are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include a base made of CoFeB in the device taught by Nowak. The motivation for further doing so, as is taught by Sato is to improve the quality of the tunnel barrier film (paragraph 0066). In addition, it would have been obvious to combines the references since the substitution of one known element for another yields predictable results to one of ordinary skill in the art. Therefore, it would have been obvious to combine Sato with Nowak and Lee to obtain the invention of claims 5-7 and 13-15.

Double Patenting

4. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Art Unit: 2815

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

5. Claims 2-4 and 8-12 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-10 of U.S. Patent No. 7,259,942 B2 in view of Nowak et al. (US 7,453,084 B2), and further in view of Sato et al. (US 2006/0256484 A1).

Regarding claims 2 and 8-9, Childress discloses a magnetic tunnel transistor (MTT) comprising:

a ferromagnetic base (Base Region 704) [Fig. 7];

a ferromagnetic emitter structure (Emitter Region 702) [Fig. 7 and col. 8, lines 9-11]; and

a ferromagnetic collector that does not include GaAs [Fig. 7 and col. 8, lines 12-14].

Nowak discloses a barrier layer of TiO (18) disposed between the collector and the base, having a barrier height of less than three-tenths of an electron volt [Fig. 1 and col. 3, lines 65-67 and col. 4, lines 21-22 and 25-27].

Regarding claims 3 and 11, Nowak teaches a barrier layer (14) made of a metal oxide [Fig. 1 and col. 31-33].

Childress and Nowak are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include a barrier layer of TiO (18) disposed between the collector and the base, having a barrier height of less than three-

Art Unit: 2815

tenths of an electron volt in the device as taught by Childress. The motivation for doing so, as is taught by Nowak, is increase the collector current density (col. 4, lines 2-8). In addition, the court has held that it is within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416 (CCPA 1960); *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). Therefore, it would have been obvious to combine Lee with Nowak to obtain the invention of claims 2-3, 8-9 and 11.

Regarding claims 4 and 12, Childress discloses wherein the collector is made of NiFe and/or CoFe [col. 8, lines 12-14].

Regarding claim 10, Childress discloses a ferromagnetic collector that does not include GaAs [Fig. 7 and col. 8, lines 12-14].

Regarding claims 5-7 and 13-15, the combination of prior art references substantially teaches the claimed invention except for a base made of CoFeB.

Sato teaches a CoFeB/MgO/CoFeB/Ru/CoFe (13-18) [paragraphs 0053, 0054, 0056, 0062, 0066, 0069, 0072].

Childress, Nowak and Sato are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include a base made of CoFeB in the device taught by Nowak. The motivation for further doing so, as is taught by Sato is to improve the quality of the tunnel barrier film (paragraph 0066). In addition, it would

have been obvious to combines the references since the substitution of one known element for another yields predictable results to one of ordinary skill in the art. Therefore, it would have been obvious to combine Sato with Childress and Nowak to obtain the invention of claims 5-7 and 13-15.

Response to Arguments

6. Applicant's arguments with respect to claims 2-15 have been considered but are moot in view of the new ground(s) of rejection.

Correspondence

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOSE R. DIAZ whose telephone number is (571)272-1727. The examiner can normally be reached on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2815

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Kenneth A Parker/
Supervisory Patent Examiner, Art Unit 2815

/J. R. D./
Examiner, Art Unit 2815

Notice of References Cited	Application/Control No. 11/350,226		Applicant(s)/Patent Under Reexamination GILL, HARDAYAL SINGH	
	Examiner JOSE R. DIAZ		Art Unit 2815	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-7,453,084	11-2008	Nowak et al.	257/30
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Lee et al., "Large Magnetocurrents in Double-barrier Tunneling Transistors", Journal of Magnetism and Magnetic Materials, Feb. 2005, vol. 286, p.138-41.
	V	Åkerman et al., "Criteria for Ferromagnetic-Insulator-Ferromagnetic tunneling", Journal of Magnetism and Magnetic Materials, Feb. 2002, vol. 240, no. 1-3, p.86-91.
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

<i>Index of Claims</i> 	Application/Control No. 11350226	Applicant(s)/Patent Under Reexamination GILL, HARDAYAL SINGH
	Examiner JOSE R DIAZ	Art Unit 2815

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant
 ☐ CPA
 ☐ T.D.
 ☐ R.1.47

CLAIM		DATE								
Final	Original	06/08/2009	10/08/2009							
	1	✓	-							
	2	✓	✓							
	3	✓	✓							
	4	✓	✓							
	5	✓	✓							
	6	✓	✓							
	7	✓	✓							
	8	✓	✓							
	9	✓	✓							
	10	✓	✓							
	11	✓	✓							
	12	✓	✓							
	13	✓	✓							
	14	✓	✓							
	15	✓	✓							
	16	N	N							
	17	N	N							
	18	N	N							
	19	N	N							
	20	N	N							

Search Notes 	Application/Control No. 11350226	Applicant(s)/Patent Under Reexamination GILL, HARDAYAL SINGH
	Examiner JOSE R DIAZ	Art Unit 2815

SEARCHED			
Class	Subclass	Date	Examiner
257	29,E21.208	6/8/09	JRD

SEARCH NOTES		
Search Notes	Date	Examiner
Text Search EAs. See search history printout. 257/295; 360/324.2	6/08/09	JRD
Text Search EAs. See search history printout.	10/8/09	JRD

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L6	3413	collector near15 ((ferro\$2 near1 magnetic\$2) or ferromagnetic or iron or fe)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/08 09:46
L7	74028	base near15 ((ferro\$2 near1 magnetic\$2) or ferromagnetic or iron or fe)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/08 09:46
L8	4546	emitt\$3 near15 ((ferro\$2 near1 magnetic\$2) or ferromagnetic or iron or fe)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/08 09:46
L9	160	6 and 7 and 8	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/08 09:46
L10	135	9 not (@ad> "20060208" or @rlad> "20060208")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/08 09:47
L14	8	((("20040218314") or ("200310214004") or ("200510226043") or ("6,480,365") or ("20050225905") or ("5,291,274")).PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/10/08 12:04
L15	12	((("20040218314") or ("20030214004") or ("20050226043") or ("6,480,365") or ("20050225905") or ("5,291,274")).PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/10/08 12:05
L16	2	("20070183100").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/10/08 12:06

L17	310	(barrier near5 height) same (tio or alumina or (alumnium near oxide) or ("al.sub.2" near1 "o.sub.3") or "al.sub.2o.sub.3" or "al.sub.2 o.sub.3")	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/08 12:10
L18	102	(barrier near5 height) near15 (tio or alumina or (alumnium near oxide) or ("al.sub.2" near1 "o.sub.3") or "al.sub.2o.sub.3" or "al.sub.2 o.sub.3")	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/08 12:12
L19	2	("6535365").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/10/08 12:19
L20	2	("6671141").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/10/08 12:45
L21	0	("((titaniumnearoxide)or"tio") samebarrier").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/10/08 12:50
L22	4474	((titanium near oxide) or "tio") same barrier	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/08 12:51
L23	94	collector and base and 22	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/08 12:51
L24	1	(11/136282).APP.	USPAT; USOCR	OR	ON	2009/10/08 12:55
L25	2	("20060256484").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/10/08 13:19

L26	0	jp08129352	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/08 13:42
L27	2	"08129352"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/08 13:42
L28	2	("20060256484").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/10/08 14:16
S1	2	("7259942").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/10/07 14:18
S2	2	("20070183100").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/10/07 14:19
S3	0	("(mttor(magneticnear1tunnel)) and(barriernear15 (titaniumortioor"tio.sub.2"or"tio. sub.x"))").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2009/10/07 14:24
S4	227	(mtt or (magnetic near1 tunnel)) and (barrier near15 (titanium or tio or "tio.sub.2" or "tio.sub.x"))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/07 14:24
S5	0	(12/079036).APP.	USPAT; USOCR	OR	ON	2009/10/07 14:25
S6	165	S4 not (@ad> "20060208" or @rlad> "20060208")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/07 14:27

S7	12	S6 and collector	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/07 14:36
S8	267	(mtt or (magnetic near1 tunnel \$4)) and (barrier near15 (titanium or tio or "tio.sub.2" or "tio.sub.x"))	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/07 14:38
S9	178	S8 not (@ad> "20060208" or @rlad> "20060208")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/07 14:38
S10	12	S9 and collector	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2009/10/07 14:38
S11	16	("20030197984" "20040175596" "20050025999" "20050226043" "20050282379" "20060033145" "20060043443" "20060118839" "4700211" "6611405" "6751074" "6818458" "6833598" "7001680" "7230804" "7276384").PN. OR ("7372674"). URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2009/10/07 14:54
S12	24	("20020024780" "20020044398" "20020064595" "4847666" "5206590" "5390061" "5521500" "5747859" "5757056" "5962905" "6052263" "6069820" "6072718" "6124711" "6165287" "6191926" "6219208" "6396734" "6480365" "6636398" "6919608" "7016167").PN. OR ("7230804"). URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2009/10/07 15:05

EAST Search History (Interference)

<This search history is empty>

10/ 8/ 09 3:15:37 PM

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Applicant: Gill	)	Art Unit: 2815
	)	
Serial No.: 11/350,226	)	Examiner: Diaz
	)	
Filed: February 8, 2006	)	HSJ920050318US1
	)	
For: MAGNETIC TUNNEL TRANSISTOR WITH THIN	)	October 20, 2009
READ GAP FOR HEAD APPLICATIONS	)	750 B STREET, Suite 3120
	)	San Diego, CA 92101
	)	

RESPONSE TO OFFICE ACTION

Commissioner for Patents
Alexandria, VA

Dear Sir:

This responds to the Office Action dated October 15, 2009.

1159-63AM2

CASE NO.: HSJ920050318US1
Serial No.: 11/350,226
October 20, 2009
Page 2

PATENT
Filed: February 8, 2006

1 (canceled).

2. (previously presented) A magnetic tunnel transistor (MTT) comprising:
- a ferromagnetic base;
 - a ferromagnetic emitter structure;
 - a ferromagnetic collector that does not include GaAs; and
 - a barrier layer of TiO disposed between the collector and the base.

3. (original) The MTT of Claim 2, comprising a barrier layer of MgO disposed between the base and the emitter structure.

4. (original) The MTT of Claim 2, wherein the collector is made of NiFe and/or CoFe.

5. (original) The MTT of Claim 2, wherein the base is made of CoFeB.

6. (original) The MTT of Claim 2, wherein the emitter structure includes a layer of Ru disposed between a layer of CoFeB and a layer of CoFe.

7. (original) The MTT of Claim 6, wherein the emitter structure is pinned by a pinning layer.

8. (currently amended) A magnetic tunnel transistor (MTT) comprising:

1189-63AM2

CASE NO.: HSJ920050318US1
Serial No.: 11/350,226
October 20, 2009
Page 3

PATENT
Filed: February 8, 2006

a ferromagnetic base;

a ferromagnetic emitter structure;

a ferromagnetic collector; [[and]]

a barrier layer between the collector and base and having a barrier height of less than three-tenths of an electron volt; and

a barrier layer of MgO disposed between the base and the emitter structure.

9. (original) The MTT of Claim 8, wherein the barrier layer is made of TiO.

10. (original) The MTT of Claim 9, wherein the collector does not include GaAs.

11. (canceled).

12. (original) The MTT of Claim 9, wherein the collector is made of NiFe and/or CoFe.

13. (original) The MTT of Claim 9, wherein the base is made of CoFeB.

14. (original) The MTT of Claim 9, wherein the emitter structure includes a layer of Ru disposed between a layer of CoFeB and a layer of CoFe.

15. (original) The MTT of Claim 14, wherein the emitter structure is pinned by a pinning layer.

1189-63AM2

CASE NO.: HSJ920050318US1
Serial No.: 11/350,226
October 20, 2009
Page 4

PATENT
Filed: February 8, 2006

16. (withdrawn) A read head for a disk drive, comprising:

a magnetic tunnel transistor (MTT) including a barrier of TiO disposed between a ferromagnetic collector and a ferromagnetic base.

17. (withdrawn) The read head of Claim 16, in combination with a disk drive.

18. (withdrawn) The read head of Claim 16, comprising an emitter structure separated from the base by a barrier.

19. (withdrawn) The read head of Claim 16, wherein the collector does not include GaAs.

20. (withdrawn) The read head of Claim 18, wherein the collector is made of NiFe and/or CoFe, the base is made of CoFeB, and the emitter structure includes a layer of Ru disposed between a layer of CoFeB and a layer of CoFe.

1189-63AM2

CASE NO.: HSJ920050318US1
Serial No.: 11/350,226
October 20, 2009
Page 5

PATENT
Filed: February 8, 2006

Remarks

Reconsideration of the application is requested. Claims 2-4 and 8-12 have been rejected under 35 U.S.C. §103 as being unpatentable over Nowak, USPN 7,453,084 in view of Lee (publication), and Claims 5-7 and 13-15 have been rejected under 35 U.S.C. §103 as being unpatentable over Nowak in view of Lee and Sato, USPP 2006/0256484. Obviousness-type double patenting rejections have also been levied on the basis of USPN 7,259,954 in view of Nowak and Sato, and these rejections are noted. Overcoming the double patenting rejections by filing a terminal disclaimer with the requisite fee will be held in abeyance until there are no further impediments to patentability.

The limitation of now-canceled Claim 11 has been moved into Claim 8.

Claims 1 and 10

The allegation that Nowak, figure 1 and col. 5, lines 7-9 teaches that the collector does not have GaAs is clear error. The relied-upon section of Nowak teaches that the collector need not be made from a single-crystal semiconductor, and says nothing about GaAs. While one form of GaAs may be epitaxially-grown single crystals, alloys also may be made from GaAs and aluminum, phosphorus, antimony, or indium. In other words, while some single crystals are GaAs, some combinations of GaAs are in alloys, meaning that the tacit syllogism underpinning the rejection is false. A teaching that a collector need not be made from a single crystal semiconductor is not the same thing as a teaching that the collector does not include GaAs. Claim 2 and its dependent claims are patentable.

Claims 3 and 8

The allegation that Nowak, figure 1 and "col. 31-33" (sic, col. 1, lines 33-35) teach the limitation of Claim 3 that the base-emitter barrier is made of MgO is clear error. The relied-upon portion of Nowak teaches

1189-63AM2

CASE NO.: HSI920050318US1
Serial No.: 11/350,226
October 20, 2009
Page 6

PATENT
Filed: February 8, 2006

that the emitter-base barrier 14 is made of metal oxide such as aluminum oxide and nowhere mentions that it is made of the specific compound claimed.

Claims 5 and 13

The allegation that the CoFeB pinned layer 13 of the ferromagnetic tunnel junction device for a read head of Sato may be combined with Nowak and Lee to arrive at Claim 5 (the base of a magnetic tunnel transistor being made of CoFeB) is clear error. Nowhere does Sato even mention the concepts of a base or emitter or collector; it is not directed to an MTT, but rather to a ferromagnetic junction device. There is thus no suggestion that its layer 13 be used in a structure which is not contemplated by Sato.

In addition, the prior examiner made a finding of fact on the written record that the elected claims were patentably distinct from the non-elected claims because the elected claims have "separate utility such as usable in a memory as opposed to a read head". However, the present examiner's use of Sato in the present rejection diametrically contradicts the basis for the restriction, see, e.g., the title of Sato. Accordingly, it is respectfully submitted that for consistency, the restriction requirement be withdrawn and the non-elected claims be rejoined and allowed, or that Sato be removed as a reference.

Claims 6, 7, 14, and 15

The same comments apply to the rejections of Claims 6 and 7 (reciting specific emitter structure) based on teachings from Sato. Sato nowhere suggests that the relied-upon constituents should be used, much less would work with, MTTs.

1189-63AM2

CASE NO.: HSJ920050318US1
Serial No.: 11/350,226
October 20, 2009
Page 7

PATENT
Filed: February 8, 2006

The Examiner is cordially invited to telephone the undersigned at (619) 338-8075 for any reason which would advance the instant application to allowance.

Respectfully submitted,



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JLR:jg

1189-63AM2



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/350,226	02/08/2006	Hardayal Singh Gill	HSJ920050318US1	9816
24955 7590 01/06/2010 ROGITZ & ASSOCIATES 750 B STREET SUITE 3120 SAN DIEGO, CA 92101			EXAMINER DIAZ, JOSE R	
			ART UNIT 2815	PAPER NUMBER
			MAIL DATE 01/06/2010	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.		Applicant(s)	
	11/350,226		GILL, HARDAYAL SINGH	
	Examiner		Art Unit	
	JOSE R. DIAZ		2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on 20 October 2009.

2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) 2-10 and 12-20 is/are pending in the application.

4a) Of the above claim(s) 16-20 is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) 2-10 and 12-15 is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☐ All b) ☐ Some * c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. _____.

3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 2-4, 8-10 and 12 are rejected under 35 U.S.C. 103(a) as being obvious over Nowak et al. (US 7,453,084 B2) in view of Lee et al. ("Large Magnetocurrents in Double-barrier Tunneling Transistors", Journal of Magnetism and Magnetic Materials, Feb. 2005, vol. 286, p.138-41).

Regarding claims 2 and 8-10, Nowak discloses a magnetic tunnel transistor (MTT) comprising:

a base (16) [Fig. 1];

a ferromagnetic emitter structure (12) [Fig. 1 and col. 3, lines 35-36]; and

a collector (20) that does not include GaAs [Fig. 1 and col. 5, lines 7-9].

a barrier layer of TiO (18) disposed between the collector and the base, having a barrier height of less than three-tenths of an electron volt [Fig. 1 and col. 3, lines 65-67 and col. 4, lines 21-22 and 25-27].

Nowak substantially discloses the claimed invention except for a ferromagnetic base and a ferromagnetic collector.

Lee teaches a MTT structure comprising a ferromagnetic emitter, a ferromagnetic base and a ferromagnetic collector [abstract].

Regarding claims 4 and 12, Lee teaches a collector made of NiFe and/or CoFe [Fig. 1 and Section 3, first paragraph].

Nowak and Lee are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include ferromagnetic layers serving as the emitter, base and collector in the device as taught by Nowak. The motivation for doing so, as is taught by Lee, is increase the collector current density (abstract). In addition, the court has held that it is within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416 (CCPA 1960); *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). Therefore, it would have been obvious to combine Lee with Nowak to obtain the invention of claims 2, 4, 8-10 and 12.

Regarding claim 3, Nowak teaches a barrier layer (14) made of a metal oxide [Fig. 1 and col. 3, lines 31-33].

3. Claims 5-7 and 13-15 are rejected under 35 U.S.C. 103(a) as being obvious over Nowak et al. (US 7,453,084 B2) in view of Lee et al. ("Large Magnetocurrents in Double-barrier Tunneling Transistors", *Journal of Magnetism and Magnetic Materials*, Feb. 2005, vol. 286, p.138-41), and further in view of Sato et al. (US 2006/0256484 A1).

Regarding claims 5-7 and 13-15, the combination of prior art references substantially teaches the claimed invention except for a base made of CoFeB.

Sato teaches a CoFeB/MgO/CoFeB/Ru/CoFe (13-18) [paragraphs 0053, 0054, 0056, 0062, 0066, 0069, 0072].

Nowak, Lee and Sato are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include a base made of CoFeB in the device taught by Nowak. The motivation for further doing so, as is taught by Sato is to improve the quality of the tunnel barrier film (paragraph 0066). In addition, it would have been obvious to combines the references since the substitution of one known element for another yields predictable results to one of ordinary skill in the art. Therefore, it would have been obvious to combine Sato with Nowak and Lee to obtain the invention of claims 5-7 and 13-15.

Double Patenting

4. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Art Unit: 2815

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

5. Claims 2-4, 8-10 and 12 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-10 of U.S. Patent No. 7,259,942 B2 (Childress) in view of Nowak et al. (US 7,453,084 B2), and further in view of Sato et al. (US 2006/0256484 A1).

Regarding claims 2 and 8-9, Childress discloses a magnetic tunnel transistor (MTT) comprising:

a ferromagnetic base (Base Region 704) [Fig. 7];

a ferromagnetic emitter structure (Emitter Region 702) [Fig. 7 and col. 8, lines 9-11]; and

a ferromagnetic collector that does not include GaAs [Fig. 7 and col. 8, lines 12-14].

Nowak discloses a barrier layer of TiO (18) disposed between the collector and the base, having a barrier height of less than three-tenths of an electron volt [Fig. 1 and col. 3, lines 65-67 and col. 4, lines 21-22 and 25-27].

Regarding claim 3, Nowak teaches a barrier layer (14) made of a metal oxide [Fig. 1 and col. 31-33].

Childress and Nowak are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include a barrier layer of TiO (18) disposed between the collector and the base, having a barrier height of less than three-

tenths of an electron volt in the device as taught by Childress. The motivation for doing so, as is taught by Nowak, is increase the collector current density (col. 4, lines 2-8). In addition, the court has held that it is within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416 (CCPA 1960); *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). Therefore, it would have been obvious to combine Lee with Nowak to obtain the invention of claims 2-3, 8-9 and 11.

Regarding claims 4 and 12, Childress discloses wherein the collector is made of NiFe and/or CoFe [col. 8, lines 12-14].

Regarding claim 10, Childress discloses a ferromagnetic collector that does not include GaAs [Fig. 7 and col. 8, lines 12-14].

Regarding claims 5-7 and 13-15, the combination of prior art references substantially teaches the claimed invention except for a base made of CoFeB.

Sato teaches a CoFeB/MgO/CoFeB/Ru/CoFe (13-18) [paragraphs 0053, 0054, 0056, 0062, 0066, 0069, 0072].

Childress, Nowak and Sato are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include a base made of CoFeB in the device taught by Nowak. The motivation for further doing so, as is taught by Sato is to improve the quality of the tunnel barrier film (paragraph 0066). In addition, it would

have been obvious to combines the references since the substitution of one known element for another yields predictable results to one of ordinary skill in the art. Therefore, it would have been obvious to combine Sato with Childress and Nowak to obtain the invention of claims 5-7 and 13-15.

Response to Arguments

6. Applicant's arguments filed October 20, 2009 have been fully considered but they are not persuasive.

With regards to claims 1 and 10, applicant argued that the reference fail to teach the limitation "the collector that does not include GaAs". However, the examiner disagrees. For instance, Nowak discloses a collector 20 made of metal (col. 3, lines 33-34). Since GaAs is not a metal material, the collector in Nowak "does not include GaAs". In addition, Lee teaches a collector made of, for example, of CoFe [Fig. 1]. Therefore, the combination of Nowak and Lee renders the argued limitation obvious.

With regards to claims 3 and 8, applicant argued that Nowak fails to teach a barrier made of MgO. As stated in the previous rejection, Nowak discloses a barrier (14) made of metal oxide [Col. 3, lines 31-32]. Nowak makes obvious the claimed material since MgO is a metal oxide. In addition, using MgO as barrier layer is very well known in the art. For instance, Figs. 1(B) and 2(C) in WO 2005/088745, now EP 1 737 0 55 A1, teaches MgO as a barrier layer; and paragraph 0020 in US 2004/0229430 A1, teaches a MgO barrier layer as an obvious equivalent to an aluminum oxide barrier layer. The court has held that it is within the general skill of a worker in the art to select a known

material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416 (CCPA 1960); *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). Therefore, applicant arguments are not persuasive since Nowak makes obvious the use of a very well known metal oxide material as the barrier layer.

With regards to claims 5-7 and 13-15, a MTT device, as it is known in the art, is merely a MTJ device “married “ to a collector, wherein one FE electrode in the MTJ device forms the emitter, and the other FE layer forms the base [paragraph 0112 of US 2008/0138660 A1]. Thus, applicant arguments are not persuasive since MTJ devices are merely very well known components of MTT devices, hence any teaching described for an MTJ device can also be applied for a MTT device.

As such the rejections are considered to be proper.

Conclusion

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

Art Unit: 2815

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Correspondence

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOSE R. DIAZ whose telephone number is (571)272-1727. The examiner can normally be reached on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Kenneth A Parker/
Supervisory Patent Examiner, Art Unit 2815

/J. R. D./
Examiner, Art Unit 2815

Application/Control Number: 11/350,226
Art Unit: 2815

Page 10

Notice of References Cited	Application/Control No. 11/350,226	Applicant(s)/Patent Under Reexamination GILL, HARDAYAL SINGH	
	Examiner JOSE R. DIAZ	Art Unit 2815	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2008/0138660	06-2008	Parkin, Stuart Stephen Papworth	428/812
*	B	US-2004/0229430	11-2004	Findeis et al.	438/257
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N	EP 1737055 A1	12-2006	European Patent	YUASA, SHINJI	
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.



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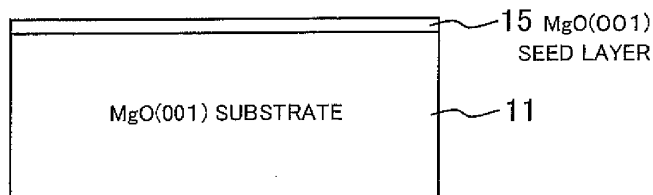
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(54) **MAGNETORESISTIVE ELEMENT AND ITS MANUFACTURING METHOD**

(57) The output voltage of an MRAM is increased by means of an Fe(001)/MgO(001)/Fe(001) MTJ device, which is formed by microfabrication of a sample prepared by the following steps. A single-crystalline MgO (001) substrate 11 is prepared. An epitaxial Fe(001) lower electrode (a first electrode) 17 with the thickness of 50 nm is grown on a MgO(001) seed layer 15 at room temperature, followed by annealing under ultrahigh vacuum (2×10^{-8} Pa) and at 350°C. A MgO(001) barrier layer 21 with the thickness of 2 nm is epitaxially formed on the Fe(001)

lower electrode (the first electrode) at room temperature, using a MgO electron-beam evaporation. A Fe(001) upper electrode (a second electrode) with the thickness of 10 nm is then formed on the MgO(001) barrier layer 21 at room temperature. This is successively followed by the deposition of a Co layer 21 with the thickness of 10 nm on the Fe(001) upper electrode (the second electrode) 23. The Co layer 21 is provided so as to increase the coercive force of the upper electrode 23 in order to realize an antiparallel magnetization alignment.

FIG. 2 (A)



EP 1 737 055 A1

FIG. 2 (B)

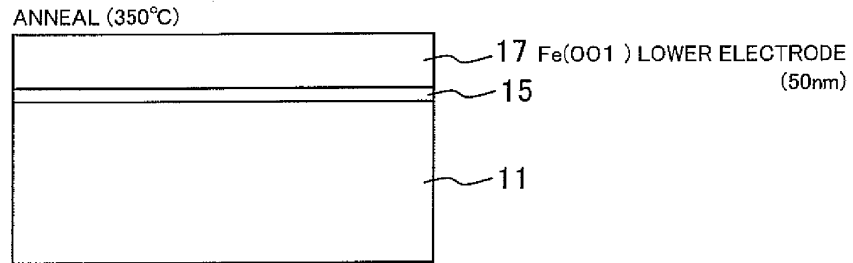


FIG. 2 (C)

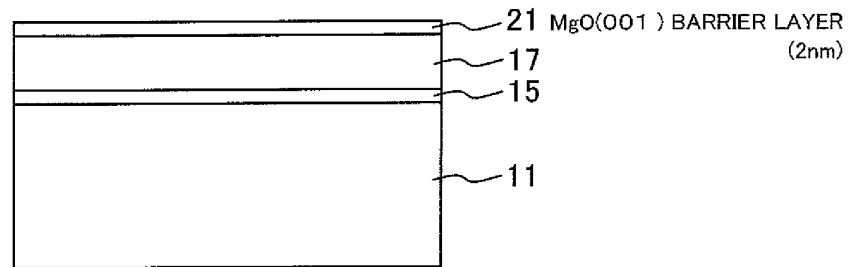
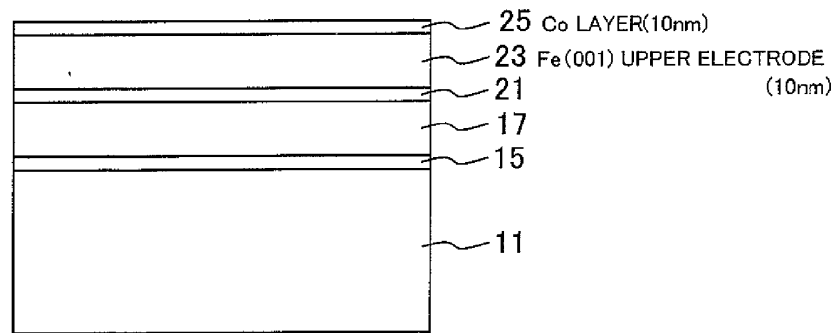


FIG. 2 (D)



Description

BACKGROUND OF THE INVENTION

5 Field of the Invention

[0001] The present invention relates to a magnetic tunnel junction device and a method of manufacturing the same, particularly to a magnetic tunnel junction device with a high magnetoresistance and a method of manufacturing the same.

10 Description of Related Art

[0002] Magnetoresistive random access memories (MRAMs) refer to a large-scale integrated memory circuit that is expected to replace the currently widely used DRAM memories. Research and development of MRAM devices, which are fast and non-volatile memory devices, are being extensively carried out, and sample products of a 4Mbit MRAM have actually been delivered.

[0003] Fig. 8 shows the structure and operation principle of a magnetic tunnel junction device (to be hereafter referred to as a "MTJ device"), which is the most important part of the MRAM. As shown in Fig. 8(A), a MTJ device comprises a tunnelling junction structure in which a tunnel barrier (to be hereafter also referred to as a "barrier layer") made of an oxide is sandwiched between a first and a second electrode made of a ferromagnetic metal. The tunnel barrier layer comprises an amorphous Al-O layer (see Non-Patent Document 1). As shown in Fig. 8(A), in the case of parallel magnetization alignment where the directions of magnetizations of the first and second ferromagnetic electrodes are aligned parallel, the electric resistance of the device with respect to the direction normal to the interfaces of the tunneling junction structure decreases. On the other hand, in the case of antiparallel magnetization alignment where the directions of magnetizations of the first and second ferromagnetic electrodes are aligned antiparallel as shown in Fig. 8(B), the electric resistance with respect to the direction normal to the interfaces of the tunneling junction structure increases. The resistance value does not change in a general state, so that information "1" or "0" can be stored depending on whether the resistance value is high or not. Since the parallel and antiparallel magnetization alignments can be stored in a non-volatile fashion, the device can be used as a non-volatile memory device.

[0004] Fig. 9 shows an example of the basic structure of the MRAM. Fig. 9(A) shows a perspective view of the MRAM, and Fig. 9(B) schematically shows a circuit block diagram. Fig. 9(C) is a cross-section of an example of the structure of the MRAM. Referring to Fig. 9(A), in an MRAM, a word line WL and a bit line BL are disposed in an intersecting manner, with an MRAM cell disposed at each intersection. As shown in Fig. 9(B), the MRAM cell disposed at the intersection of a word line and a bit line comprises a MTJ device and a MOSFET directly connected to the MTJ device. Stored information can be read by reading the resistance value of the MTJ device that functions as a load resistance, using the MOSFET. The stored information can be rewritten by applying a magnetic field to the MTJ device, for example. As shown in Fig. 9(C), an MRAM memory cell comprises a MOSFET 100 including a source region 105 and a drain region 103 both formed inside a p-type Si substrate 101, and a gate electrode 111 formed on a channel region that is defined between the source and drain regions. The MRAM also comprises a MTJ device 117. The source region 105 is grounded, and the drain is connected to a bit line BL via the MTJ device. A word line WL is connected to the gate electrode 111 in a region that is not shown.

[0005] Thus, a single non-volatile MRAM memory cell can be formed by a single MOSFET 100 and a single MTJ device 117. The MRAMs are therefore suitable where high levels of integration are required. Non-Patent Document 1: D. Wang, et al.: Science 294 (2001) 1488.

45 SUMMARY OF THE INVENTION

[0006] Although there are prospects for achieving MRAMs with capacities on the order of 64Mbits based on the current technologies, the characteristics of the MTJ device, which is the heart of MRAM, needs to be improved if higher levels of integration are to be achieved. In particular, in order to increase the output voltage of the MTJ device, the magnetoresistance must be increased and the bias voltage characteristics must be improved. Fig. 10 illustrates how the magnetoresistance in a conventional MTJ device using an amorphous Al-O as the tunnel barrier changes as a function of the bias voltage (L1). As shown, in the conventional MTJ device, the magnetoresistance is small and, notably, it tends to drastically decrease upon application of bias voltage. With such characteristics, the output voltage when operation margins are taken into consideration is too small for the device to be employed for an actual memory device. Specifically, the magnetoresistance of the current MTJ device is small at approximately 70%, and the output voltage is also small at no more than 200 mV, which is substantially half the output voltage of a DRAM. This has resulted in the problem that as the level of integration increases, signals are increasingly lost in noise and cannot be read.

[0007] It is an object of the invention to increase the output voltage of a MTJ device. It is another object of the invention

to provide a memory device with a high magnetoresistance for stable operation.

[0008] In one aspect, the invention provides a magnetoresistive device comprising a magnetic tunnel junction structure comprising: a tunnel barrier layer; a first ferromagnetic material layer of the BCC structure formed on a first side of the tunnel barrier layer; and a second ferromagnetic material layer of the BCC structure formed on a second side of the tunnel barrier layer, wherein the tunnel barrier layer is formed by a single-crystal MgO_x (001) layer or a poly-crystalline MgO_x ($0 < x < 1$) layer in which the (001) crystal plane is preferentially oriented.

[0009] The invention further provides a magnetoresistive device comprising a magnetic tunnel junction structure comprising: a tunnel barrier layer comprising MgO (001); a first ferromagnetic material layer comprising Fe (001) formed on a first side of the tunnel barrier layer; and a second ferromagnetic material layer comprising Fe (001) formed on a second side of the tunnel barrier layer, wherein the MgO layer is formed by a single-crystalline MgO_x (001) layer or a poly-crystalline MgO_x ($0 < x < 1$) layer in which the (001) crystal plane is preferentially oriented. In a preferred embodiment, the band discontinuity value (the height of the tunnel barrier) between the bottom of the conduction band of the MgO (001) layer and the Fermi energy of the Fe (001) layer is smaller than an ideal value of a perfect single-crystal without defect. These features increase the magnetoresistance and thereby allow the output voltage of the MTJ device to be increased. By using any of the aforementioned MTJ devices as a load for a single transistor, a non-volatile memory can be formed.

[0010] In another aspect, the invention provides a method of manufacturing a magnetoresistive device comprising: preparing a substrate; depositing a first Fe (001) layer on the substrate; depositing a tunnel barrier layer on the first Fe (001) layer by electron beam evaporation under high vacuum, the tunnel barrier layer comprising a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented; and forming a second Fe (001) layer on the tunnel barrier layer.

[0011] The invention furthermore provides a method of manufacturing a MTJ device comprising a first step of preparing a substrate comprising a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented, a second step of depositing a first Fe (001) layer on the substrate and performing an annealing process to make the surface flat, a third step of depositing a tunnel barrier layer on the first Fe (001) layer by electron beam evaporation, the tunnel barrier layer comprising a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented, and a fourth step of forming a second Fe (001) layer on the tunnel barrier layer. The method may further comprise the step of growing a seed layer between the first and the second steps, the seed layer comprising a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented. The MgO layer may be deposited using a target with the value of x in MgO_x adjusted. The value of x in MgO_x may be adjusted in the step of forming the MgO .

[0012] In yet another aspect, the invention provides a magnetoresistive device comprising a magnetic tunnel junction structure comprising a tunnel barrier layer comprising MgO (001), a first ferromagnetic material layer comprising an amorphous magnetic alloy formed on a first side of the tunnel barrier layer, and a second ferromagnetic material layer comprising an amorphous magnetic alloy formed on a second side of the tunnel barrier layer, wherein the discontinuous value (the height of the tunnel barrier) between the bottom of the conduction band of the MgO (001) layer and the Fermi energy of the first or the second ferromagnetic material layer comprising the amorphous magnetic alloy is lower than an ideal value of a perfect single-crystal with no defect.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1(B) shows the structure of a MTJ device according to a first embodiment of the invention, and Fig. 1(A) shows the energy band structure of a ferromagnetic metal Fe (001), illustrating the $E-E_F$ relationship with respect to the [001] direction of the momentum space.

Fig. 2(A) to Fig. 2(D) schematically show the process of manufacturing a MTJ device with a Fe (001)/ MgO (001)/ Fe (001) structure (to be hereafter referred to as a " Fe (001)/ MgO (001)/ Fe (001) MTJ device") according to an embodiment of the invention.

Fig. 3(A) shows a RHEED image of a Fe (001) lower electrode (a first electrode), and Fig. 3(B) shows a RHEED image of a MgO (001) barrier layer.

Fig. 4 shows the results of observing the quadrupole mass spectra in the deposition chamber during the MgO evaporation.

Fig. 5 shows the film deposition rate dependency of the oxygen partial pressure during the MgO evaporation.

Fig. 6 shows typical magnetoresistance curves of the Fe (001)/ MgO (001)/ Fe (001) MTJ device.

Fig. 7(A) shows the bias voltage dependency of the MR ratio at room temperature, and Fig. 7(B) shows the output voltage V_{out} of the MTJ device ($=\text{bias voltage} \times (\text{Rap}-\text{Rp})/\text{Rap}$).

Fig. 8 shows the structure of the MTJ device and its operating principle.

Fig. 9 shows an example of the basic structure of an MRAM, Fig. 9(A) showing a perspective view of the MRAM, Fig. 9(B) showing a schematic circuit diagram, and Fig. 9(C) showing a cross-sectional view of an example of its structure.

Fig. 10 shows how the magnetoresistance of a conventional MTJ device using an amorphous Al-O as the tunnel barrier changes depending on the bias voltage.

Fig. 11 shows the structure of a MTJ device according to a variation of the invention, corresponding to Fig. 1(B).

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] In the context of the present specification, because MgO has a cubic crystal structure (NaCl structure), the (001) plane, the (100) plane, and the (010) plane are all equivalent. The direction perpendicular to the film surface is herein considered to be the z-axis so that the film plane can be uniformly described as (001). Also in the context of the present specification, BCC structure, which the crystalline structure of ferromagnetic electrode layer, means body-centered cubic lattice structure. More specifically, BCC structure includes the BCC structure with no chemical ordering so-called A2-type structure, the BCC structure with chemical ordering such as B2-type structure and L2₁-type structure, and also the aforementioned structures with slight lattice distortion.

[0015] The term "ideal value" with regard to a perfect single-crystal without defect herein refers to a value that has been estimated from ultraviolet photoemission spectroscopy experiments (see W. Wulfhekel, et al.: Appl. Phys. Lett. 78 (2001) 509.). The term "ideal value" is used herein because the aforementioned state can be considered to be an upper limit value of the potential barrier height of the tunnel barrier of an ideal single-crystal MgO with hardly any oxygen vacancy defect or lattice defect.

[0016] Before describing the preferred embodiments of the invention, an analysis conducted by the inventors is discussed. The magnetoresistance (MR) ratio of a MTJ device can be expressed by the following equation:

$$\Delta R/R_p = (R_{ap} - R_p)/R_p$$

where R_p and R_{ap} indicate the tunnel junction resistance in the cases of parallel and antiparallel magnetization alignments, respectively, of two electrodes. According to the Jullire's formula, the MR ratio at low bias voltage can be expressed by:

$$\text{MR ratio} = (R_{ap} - R_p)/R_p = 2P_1P_2/(1-P_1P_2),$$

and

$$P\alpha = (D\alpha \uparrow (E_F) - D\alpha \downarrow (E_F))/(D\alpha \uparrow (E_F) + D\alpha \downarrow (E_F)),$$

$$\text{where } \alpha = 1, 2 \quad (1)$$

[0017] In the above equations, $P\alpha$ is the spin polarization of an electrode, and $D\alpha \uparrow (E_F)$ and $D\alpha \downarrow (E_F)$ are the density of state (DOS) at the Fermi energy (E_F) of the majority-spin band and the minority-spin band, respectively. Since the spin polarization of ferromagnetic transition metals and alloys is approximately 0.5 or smaller, the Jullire's formula predicts a highest estimated MR ratio of about 70%.

[0018] Although the MR ratio of approximately 70% has been obtained at room temperature when a MTJ device was made using an amorphous Al-O tunnel barrier and polycrystalline electrodes, it has been difficult to obtain the output voltage of 200 mV, which is comparable to the output voltages of DRAMs, thereby preventing the realization of MRAM as mentioned above.

[0019] The inventors tried an approach to deposit a MTJ device in which the tunnel barrier comprises a single-crystal (001) of magnesium oxide (MgO) or a poly-crystalline MgO in which the (001) crystal plane is preferentially oriented. It is the inventors' theory that, because magnesium oxide is a crystal (where the atoms are arranged in an orderly fashion), as opposed to the conventional amorphous Al-O barrier, the electrons are not scattered and the coherent states of electrons are conserved during the tunneling process. Fig. 1(B) shows the MTJ device structure according to an embodiment of the invention. Fig. 1(A) shows the energy band structure of the ferromagnetic Fe(001), that is, the $E-E_F$

relationship with respect to the [001] direction of the momentum space. As shown in Fig. 1(B), the MTJ device structure of the present embodiment comprises a first Fe (001) layer 1, a second Fe (001) layer 5, and a single-crystalline MgO_x (001) layer 3 or a poly-crystalline MgO_x ($0 < x < 1$) layer 3 sandwiched therebetween, the polycrystalline layer having the (001) crystal plane preferentially oriented therein. According to the aforementioned Julliere's model, assuming that the momentum of the conduction electrons is preserved in the tunneling process, the tunneling current that passes through MgO would be dominated by those electrons with wave vector k_z in the direction perpendicular to the tunnel barrier (normal to the junction interfaces). In accordance with the energy band diagram shown in Fig. 1(A) of Fe in the [001] (Γ -H) direction, the density of state (DOS) at the Fermi energy E_F does not exhibit a very high spin polarization due to the fact that the sub-bands of the majority-spin and the minority-spin have states at the Fermi energy E_F . However, in case the coherent states of electrons are conserved in the tunneling process, only those conduction electrons that have totally symmetrical wave functions with respect to the axis perpendicular to the barrier would be coupled with the states in the barrier region and come to have a finite tunneling probability. The Δ_1 band in the Fe(001) electrode has such totally symmetric wave functions. As shown in Fig. 1(A), the majority spin Δ_1 band (solid line) has states at the Fermi energy E_F , whereas the minority spin Δ_1 band (broken line) does not have state at the Fermi energy E_F . Because of such half-metallic characteristics of the Fe Δ_1 band, there is the possibility that a very high MR ratio can be obtained in a coherent spin polarized tunneling. Since in an epitaxial (single-crystal, or (001) oriented poly-crystal) MTJ device the scattering of electrons is suppressed during the tunneling process, an epitaxial MTJ device is thought to be ideal for realizing the aforementioned coherent tunneling.

[0020] In the following, a MTJ device according to a first embodiment of the invention and a method of manufacturing the same will be described with reference to the drawings. Figs. 2(A) to 2(D) schematically show the method of manufacturing the MTJ device having the Fe (001)/MgO(001)/Fe(001) structure according to the embodiment (to be hereafter referred to as a "Fe(001)/MgO(001)/Fe(001) MTJ device"). Fe(001) refers to a ferromagnetic material with the BCC structure. First, a single-crystal MgO(001) substrate 11 was prepared. In order to improve the morphology of the surface of the single-crystal MgO(001) substrate 11, a MgO(001) seed layer 15 was grown by the molecular beam epitaxy (MBE) method. This was subsequently followed by the growth of an epitaxial Fe(001) lower electrode (first electrode) 17 with the thickness of 50 nm on the MgO(001) seed layer 15 at room temperature, as shown in Fig. 1(B), and then annealing was performed at 350°C under ultrahigh vacuum (2×10^{-8} Pa). Electron-beam evaporation conditions included an acceleration voltage of 8 kV, a growth rate of 0.02 nm/sec, and the growth temperature of room temperature (about 293K). The source material of the electron-beam evaporation was MgO of the stoichiometric composition (the ratio of Mg to O being 1:1), the distance between the source and the substrate was 40 cm, the base vacuum pressure was 1×10^{-8} Pa, and the O_2 partial pressure was 1×10^{-6} Pa. Alternatively, a source with oxygen vacancy defects may be used instead of the MgO of the stoichiometric composition (the ratio of Mg to O is 1:1).

[0021] Fig. 3(A) shows a RHEED image of the Fe(001) lower electrode (a first electrode). The image shows that the Fe(001) lower electrode (first electrode) 17 possesses a good crystallinity and flatness. Thereafter, a MgO(001) barrier layer 21 with the thickness of 2 nm was epitaxially grown on the Fe(001) lower electrode (first electrode) at room temperature, also using the MgO electron-beam evaporation method. Fig. 3(B) shows a RHEED image of the MgO(001) barrier layer 21. The image shows that the MgO(001) barrier layer 21 also possesses a good crystallinity and flatness.

[0022] As shown in Fig. 2(D), a Fe(001) upper electrode (a second electrode) 23 with the thickness of 10 nm was formed on the MgO(001) barrier layer 21 at room temperature. This was successively followed by the deposition of a Co layer 25 with the thickness of 10 nm on the Fe(001) upper electrode (second electrode) 23. The Co layer 25 is provided to increase the coercive force of the upper electrode 23 so as to realize the antiparallel magnetization alignment. The thus prepared sample was then processed by microfabrication techniques to obtain the Fe(001)/MgO(001)/Fe(001) MTJ device.

[0023] The aforementioned MgO evaporation using an electron beam involved the formation of a film under ultrahigh vacuum of 10^{-9} Torr. It can be seen that in this method, the film, even when formed on a glass substrate to the thickness of 300 nm, was colorless and transparent, showing that a good crystal film was formed. Fig. 4 shows the results of observing the quadrupole mass spectra in the deposition chamber during the MgO growth. The results show that the partial pressures regarding the spectrum P1 of O and the spectrum P2 of O_2 are high. Fig. 5 shows the film deposition rate dependency of the oxygen partial pressure during MgO evaporation. It will be seen from the figure that the oxygen partial pressure itself is high, and that the oxygen partial pressure increases as the deposition rate increases. These results indicate the separation of oxygen from MgO during the deposition of MgO. Since the separated oxygen is pumped out of the deposition chamber using vacuum pumps, there is the possibility that there are oxygen vacancy defects such as MgO_x ($0.9 < x < 1$). When there are oxygen vacancy defects, the potential barrier height of the MgO tunnel barrier is thought to decrease (such as in the range of 0.10 to 0.85 eV; more specifically, 0.2 to 0.5 eV), which is thought to result in an increase in the tunneling current. In the case of a typical Al-O tunnel barrier, the height of the tunnel barrier with respect to Fe(001) electrodes is considered to be 0.7 to 2.5 eV. An ideal tunnel barrier height of a MgO crystal is 3.6 eV, and experimental values of 0.9 to 3.7 eV have been obtained. Using the method according to the present embodiment of the invention, a tunnel barrier height of approximately 0.3 eV is expected, indicating that the resistance of the tunnel

barrier can be lowered. However, it should be noted that other factors, such as the influence of the aforementioned coherent tunneling, might also be involved. The value of x in MgO_x due to oxygen vacancy defects is such that $0.98 < x < 1$, and more preferably $0.99 < x < 1$. These are the ranges such that the sole presence of Mg is excluded and the characteristics of MgO can be basically maintained.

[0024] The aforementioned tunnel barrier height ϕ was determined by fitting the electric conductance characteristics of the MTJ device (the relationship between tunnel current density J and bias voltage V) onto the Simmons' formula (Equation (20) in a non-patent document by J. G. Simmons: J. Appl. Phys. 34, pp. 1793-1803 (1963)) based on the WKB approximation, using the least squares method. The fitting was performed using the free electron mass ($m = 9.11 \times 10^{-31}$ kg) as the electron's effective mass. When a bias voltage V (which is normally on the order of 500 mV to 1000 mV) is applied until non-linearity appears in the J-V characteristics, the height ϕ of the tunnel barrier and the effective thickness Δs of the tunnel barrier can be simultaneously determined by fitting the J-V characteristics using the Simmons' formula.

[0025] The effective thickness Δs of the tunnel barrier was determined to be smaller than the thickness of the actual MgO(001) tunnel barrier layer (t_{MgO}) determined from a cross-sectional transmission electron microscope image of the MTJ device by approximately 0.5 nm. This is the result of the effective thickness Δs of the tunnel barrier having been reduced from the actual MgO(001) layer thickness by the effect of the image potential produced at the interface between the MgO(001) layer and the alloy layer consisting mainly of Fe and Co.

[0026] It is noted that, in the event that t_{MgO} can be accurately determined using the cross-sectional transmission electron microscope (TEM) image, the height ϕ of the tunnel barrier can be more simply determined by the following technique. Namely, when the bias voltage V applied to the MTJ device is small (normally 100 mV or smaller), the tunnel current density J is proportional to the bias voltage V , such that the J-V characteristics become linear. In such a low-bias voltage region, the Simmons' formula can be described as follows:

$$J = [(2m\phi)^{1/2}/\Delta s](e/h)^2 \times \exp[-(4\pi\Delta s/h) \times (2m\phi)^{1/2}] \times V \quad (2)$$

where m is the mass of the free electron (9.11×10^{-31} kg), e is the elementary electric charge (1.60×10^{-19} C), and h is the Planck's constant (6.63×10^{-34} J·s). The effective thickness of the tunnel barrier Δs is approximately $t_{\text{MgO}} - 0.5$ nm. By fitting the J-V characteristics of the MTJ device in the low-bias voltage region onto Equation (2), the height ϕ of the tunnel barrier can be simply and yet accurately estimated.

[0027] Fig. 6 shows a typical magnetoresistance curve of the Fe(001)/MgO(001)/Fe(001) MTJ device produced by the above-described method. The MR ratio is 146% at the measurement temperature of 20K and 88% at the measurement temperature of 293K. These values represent the highest MR ratios that have so far been obtained at room temperature. Such high MR ratios cannot be explained by the spin polarization of the Fe(001) electrode and is thought rather to be related to a coherent spin-polarized tunneling. When 160 prototype MTJ devices were made, the variations regarding the MR ratio and tunneling resistance value were not more than 20%. The yield of the MTJ devices was 90% or more at the laboratory stage. These high values suggest the effectiveness of the approach of the invention. The resistance-area (RA) product of the MTJ device was on the order of a few $\text{k}\Omega\mu\text{m}^2$, which is suitable for MRAM.

[0028] Fig. 7(a) shows the bias voltage dependency of the MR ratio at room temperature. It will be seen that the bias voltage dependency of the MR ratio is fairly small. Although the characteristics are asymmetric, the voltage V_{half} at which the MR ratio is reduced in half of the zero-bias value is 1250 mV, which is a very high value. In this connection, it is noted that the voltage V_{half} at which the MR ratio is reduced in half of the zero-bias value in the conventional MTJs with Al-O tunnel barrier is 300 to 600 mV. Fig. 7(b) shows the output voltage V_{out} of the MTJ device (=bias voltage $\times$ (Rap - Rp)/Rap). The maximum value of the output voltage V_{out} is 380 mV with a positive bias. This value is about twice as large as that (a little less than 200 mV) in the case of the Al-O barrier. These high values in terms of both MR ratio and output voltage suggest the effectiveness of the technique according to the present embodiment.

[0029] Although in the above-described embodiment Fe(001) of BCC was employed, an Fe alloy of BCC, such as an Fe-Co alloy, Fe-Ni alloy, or Fe-Pt alloy, may be used instead. Alternatively, a layer of Co or Ni with the thickness of one or several monoatomic layers may be inserted between the electrode layer and the MgO(001) layer.

[0030] Hereafter, a MTJ device according to a second embodiment of the invention and a method of manufacturing the same will be described. In the method of manufacturing a Fe(001)/MgO(001)/Fe(001) MTJ device according to the present embodiment, MgO(001) is initially deposited in a poly-crystalline or amorphous state by sputtering or the like, and then an annealing process is performed such that a poly-crystal in which the (001) crystal plane is preferentially oriented or a single-crystal is obtained. The sputtering conditions were such that, for example, the temperature was room temperature (293K), a 2-inch ϕ MgO was used as a target, and sputtering was conducted in an Ar atmosphere. The acceleration power was 200 W and the growth rate was 0.008 nm/s. Because MgO that is deposited under these conditions is in an amorphous state, a crystallized MgO was obtained by increasing the temperature to 300°C from room

temperature and maintaining that temperature for a certain duration of time.

[0031] Oxygen vacancy defects may be introduced by a method whereby oxygen vacancy defects is produced during growth, a method whereby oxygen vacancy defects is introduced subsequently, or a method whereby a state with oxygen vacancy defects is subjected to an oxygen plasma process or natural oxidation so as to achieve a certain oxygen deficit level.

[0032] As described above, in accordance with the MTJ device technology of the present embodiment, an annealing process is carried out for crystallization after an amorphous MgO has been deposited by sputtering, thereby eliminating the need for large-sized equipment.

[0033] Hereafter, a MTJ device according to a variation of the embodiments of the invention will be described with reference to the drawings. Fig. 11 shows the structure of the MTJ device according to the variation, which corresponds to Fig. 1(B). As shown in Fig. 11, the MTJ device of the variation is characterized in that, as in the MTJ device of the above-described embodiments, the electrodes disposed on either side of a single-crystal $\text{MgO}_x(001)$ layer 503 or an oxygen-deficit poly-crystal MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented comprises an amorphous ferromagnetic alloy, such as CoFeB layers 501 and 505. The amorphous ferromagnetic alloy can be formed by evaporation or sputtering, for example. The resultant characteristics are substantially identical to those of the first embodiment.

[0034] As the amorphous magnetic alloy, FeCoB, FeCoBSi, FeCoBP, FeZr, and CoZr may be used, for example. Although an anneal process after the preparation of the MTJ device might cause the amorphous magnetic alloy in the electrode layers to be partially or entirely crystallized, this would not lead to a significant deterioration of the MR ratio. Thus, such a crystallized amorphous magnetic alloy may be used in the electrode layers.

[0035] While the MTJ device according to various embodiments of the invention has been described, it should be apparent to those skilled in the art that the invention is not limited to those specific embodiments and various other modifications, improvements and combinations are possible. For example, the height of the tunnel barrier may be adjusted by doping Ca or Sr, instead of introducing an oxygen vacancy defects to the MgO layer. Further, while the MgO layer has been described to be deposited by electron-beam evaporation or sputtering, it should be obvious that other deposition methods are also possible. The term "high vacuum" refers to values on the order of no more than 10^{-6} Pa in the case where oxygen is not introduced, for example. In the case where oxygen is introduced, the term refers to values on the order of 10^{-4} Pa.

[0036] In accordance with the invention, a larger magnetoresistance than in the conventional MTJ device can be obtained, and the output voltage of the MTJ device can be increased. At the same time, the resistance value of the MTJ device can be reduced so that it is optimized for MRAM. The invention thus enables the level of integration of MRAM using the MTJ device to be readily increased. In accordance with the invention, the output voltage value of the MRAM roughly doubles over prior art, making the MTJ device of the invention suitable for very large scale integrated MRAMs of gigabit class.

Claims

1. A magnetoresistive device comprising a magnetic tunnel junction structure comprising:

a tunnel barrier layer;
a first ferromagnetic material layer of the BCC structure formed on a first side of said tunnel barrier layer; and
a second ferromagnetic material layer of the BCC structure formed on a second side of said tunnel barrier layer,
wherein
said tunnel barrier layer is formed by a single-crystalline MgO_x (001) layer or a poly-crystalline MgO_x ($0 < x < 1$) layer in which the (001) crystal plane is preferentially oriented.

2. A magnetoresistive device comprising a magnetic tunnel junction structure comprising:

a tunnel barrier layer comprising $\text{MgO}(001)$;
a first ferromagnetic material layer comprising $\text{Fe}(001)$ formed on a first side on said tunnel barrier layer; and
a second ferromagnetic material layer comprising $\text{Fe}(001)$ formed on a second side on said tunnel barrier layer,
wherein
said $\text{MgO}(001)$ layer is formed by a single-crystal MgO_x (001) layer or a poly-crystal MgO_x ($0 < x < 1$) layer in which the (001) crystal plane is preferentially oriented.

3. A magnetoresistive device comprising a magnetic tunnel junction structure comprising:

a tunnel barrier layer comprising $\text{MgO}(001)$;
 a first ferromagnetic material layer formed on a first side of said tunnel barrier layer and comprising a single-crystalline (001) layer or a poly-crystalline layer of Fe or an Fe alloy of the BCC structure, said polycrystalline layer having the (001) crystal plane preferentially oriented therein;
 5 a second ferromagnetic material layer formed on a second side of said tunnel barrier layer and comprising a single-crystalline (001) layer or a poly-crystalline layer of Fe or an Fe alloy of the BCC structure, said polycrystalline layer having the (001) crystal plane preferentially oriented therein, wherein
 said tunnel barrier layer is formed by a single-crystalline MgO_x (001) layer or a poly-crystalline MgO_x ($0 < x < 1$) layer in which the (001) crystal plane is preferentially oriented, wherein
 10 the discontinuous value (the potential barrier height of the tunnel barrier) between the bottom of the conduction band of said tunnel barrier layer and the Fermi energy of at least one of said first and said second ferromagnetic layers is smaller than an ideal value in the case where the MgO (001) layer is a perfect single-crystal.

4. A magnetoresistive device comprising a magnetic tunnel junction structure comprising:

a tunnel barrier layer;
 a first ferromagnetic material layer of the BCC structure formed on a first side of said tunnel barrier layer;
 a second ferromagnetic material layer of the BCC structure formed on a second side of said tunnel barrier layer, wherein
 20 said tunnel barrier layer is formed by a single-crystalline MgO (001) layer or a poly-crystalline MgO layer in which the (001) crystal plane is preferentially oriented, wherein
 the discontinuous value (the potential barrier height of the tunnel barrier) between the bottom of the conduction band of said tunnel barrier layer and the Fermi energy of at least one of said first and said second ferromagnetic layers is smaller than an ideal value in the case where the MgO (001) layer is a perfect single-crystal.

5. The magnetoresistive device according to claim 3 or 4, wherein said discontinuous value is in the range of 0.2 to 0.5 eV.

6. The magnetoresistive device according to claim 3 or 4, wherein said discontinuous value is in the range of 0.10 to 0.85 eV.

7. A memory device comprising:

a transistor; and
 the magnetoresistive device according to any one of claims 1 to 6, wherein said magnetoresistive device is used as a load for said transistor.

8. A method of manufacturing a magnetoresistive device comprising:

preparing a substrate;
 40 depositing a first single-crystalline (001) layer or a first poly-crystalline layer of Fe or an Fe alloy of the BCC structure, said poly-crystalline layer having the (001) crystal plane preferentially oriented therein;
 depositing a tunnel barrier layer on said first (001) layer of Fe or an Fe alloy of the BCC structure under high vacuum, said tunnel barrier layer comprising a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented; and
 45 forming a second single-crystalline (001) layer or a second poly-crystalline layer of Fe or an Fe alloy of the BCC structure on said tunnel barrier layer, said polycrystalline layer having the (001) crystal plane preferentially oriented therein.

9. A method of manufacturing a magnetoresistive device comprising:

a first step of preparing a substrate comprising a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented;
 a second step of depositing a first single-crystalline (001) layer or a first poly-crystalline layer of Fe or an Fe alloy of the BCC structure, said polycrystalline layer having the (001) crystal plane preferentially oriented therein,
 55 and then carrying out an anneal process for crystallization;
 a third step of depositing a tunnel barrier layer on said first (001) layer of Fe or an Fe alloy of the BCC structure under high vacuum, said tunnel barrier layer comprising a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented; and

a fourth step of forming a second single-crystalline (001) layer or a second poly-crystalline layer of Fe or an Fe alloy of the BCC structure on said tunnel barrier layer, said poly-crystalline layer having the (001) crystal plane preferentially oriented therein.

5 10. The method of manufacturing the magnetoresistive device according to claim 8 or 9, further comprising the step of causing a seed layer to be grown between said first and said second steps, said seed layer comprising a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented.

10 11. The method of manufacturing the magnetoresistive device according to claim 8 or 9, wherein the step of forming said tunnel barrier layer comprising said single-crystalline MgO_x (001) or said polycrystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented further comprises the step of adjusting the value of x in MgO_x .

12. A method of manufacturing a magnetoresistive device comprising:

15 preparing a substrate;
depositing a first single-crystalline (001) layer or a first poly-crystalline layer of Fe or an Fe alloy of the BCC structure, said poly-crystalline layer having the (001) crystal plane preferentially oriented therein;
forming an amorphous MgO layer on said first (001) layer of Fe or an Fe alloy of the BCC structure and then
20 crystallizing said amorphous MgO layer by annealing so as to form a tunnel barrier layer comprising the single-crystalline MgO_x (001) or the poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented; and
forming a second single-crystalline (001) layer or a second poly-crystalline layer of Fe or an Fe alloy of the BCC structure on said tunnel barrier layer, said poly-crystalline layer having the (001) crystal plane preferentially oriented therein.

25 13. The method of manufacturing the magnetoresistive device according to claim 12, wherein said amorphous MgO layer is deposited by sputtering, using a target with the value of x in MgO_x adjusted.

30 14. The method of manufacturing the magnetoresistive device according to claim 12, wherein the step of forming said amorphous MgO comprises the step of adjusting the value of x in MgO_x .

15. A magnetoresistive device comprising a magnetic tunnel junction structure comprising:

35 a tunnel barrier layer;
a first ferromagnetic material layer formed on a first side of said tunnel barrier layer and comprising an amorphous magnetic alloy; and
a second ferromagnetic material layer formed on a second side of said tunnel barrier layer and comprising an amorphous magnetic alloy, wherein
40 said tunnel barrier layer is formed by a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) layer in which the (001) crystal plane is preferentially oriented.

45 16. The magnetoresistive device according to claim 15, wherein the discontinuous value (the potential barrier height of the tunnel barrier) between the bottom of the conduction band of said tunnel barrier layer and the Fermi energy of at least one of said first and said second ferromagnetic layers is smaller than an ideal value in the case where the MgO (001) layer is a perfect single-crystal.

17. A magnetoresistive device comprising a magnetic tunnel junction structure comprising:

50 a tunnel barrier layer;
a first ferromagnetic material layer formed on a first side of said tunnel barrier layer and comprising an amorphous magnetic alloy; and
a second ferromagnetic material layer formed on a second side of said tunnel barrier layer and comprising an amorphous magnetic alloy, wherein
said tunnel barrier layer is formed by a single-crystalline MgO_x (001) or a poly-crystalline MgO_x ($0 < x < 1$) layer
55 in which the (001) crystal plane is preferentially oriented, and wherein
the discontinuous value (the potential barrier height of the tunnel barrier) between the bottom of the conduction band of said tunnel barrier layer and the Fermi energy of at least one of said first and said second ferromagnetic layers is smaller than an ideal value in the case where the MgO (001) layer is a perfect single-crystal.

18. The magnetoresistive device according to claim 16 or 17, wherein said discontinuous value is in the range of 0.2 to 0.5 eV.

5 19. The magnetoresistive device according to claim 16 or 17, wherein said discontinuous value is in the range of 0.10 to 0.85 eV.

20. A memory device comprising:

10 a transistor; and
the magnetoresistive device according to any one of claims 15 to 19, wherein said magnetoresistive device is used as a load for said transistor.

21. A method of manufacturing a magnetoresistive device comprising:

15 preparing a substrate;
depositing a first ferromagnetic material layer comprising an amorphous magnetic alloy on said substrate;
forming an amorphous MgO layer on said first ferromagnetic material layer and then crystallizing said amorphous
MgO layer by annealing so as to form a tunnel barrier layer comprising a single-crystalline MgO_x (001) or a
poly-crystalline MgO_x ($0 < x < 1$) in which the (001) crystal plane is preferentially oriented; and
20 depositing a second ferromagnetic material layer comprising an amorphous magnetic alloy on said tunnel barrier layer.

22. The method of manufacturing the magnetoresistive device according to claim 21, wherein the step of forming said
25 tunnel barrier layer comprising said single-crystalline MgO_x (001) or said poly-crystalline MgO_x ($0 < x < 1$) in which
the (001) crystal plane is preferentially oriented involves deposition by sputtering using a target with the value of x
in MgO_x adjusted.

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FIG. 1 (A)

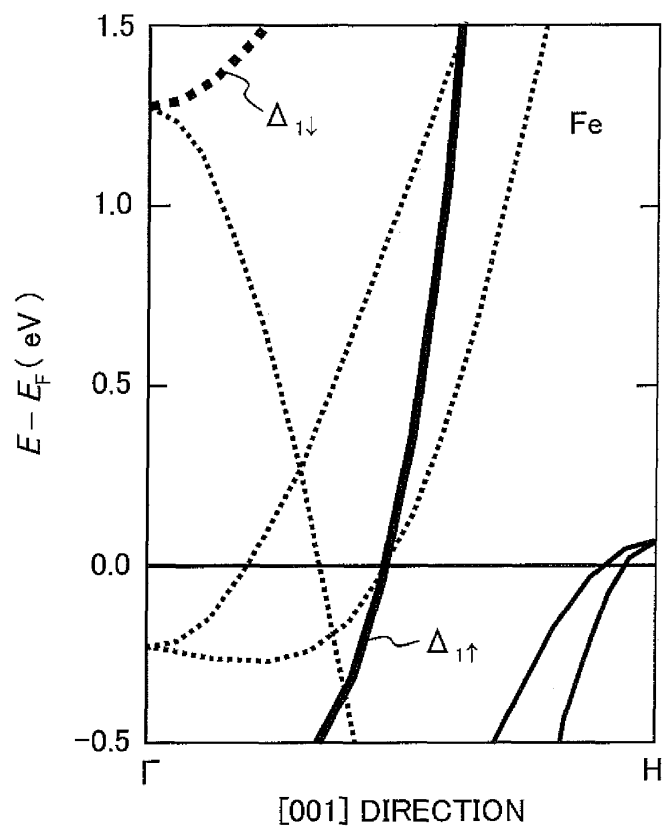


FIG. 1 (B)

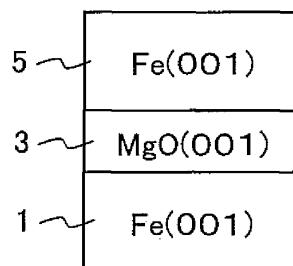


FIG. 2 (A)

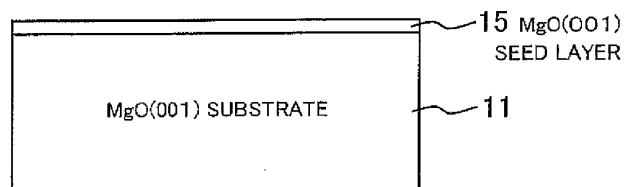


FIG. 2 (B)

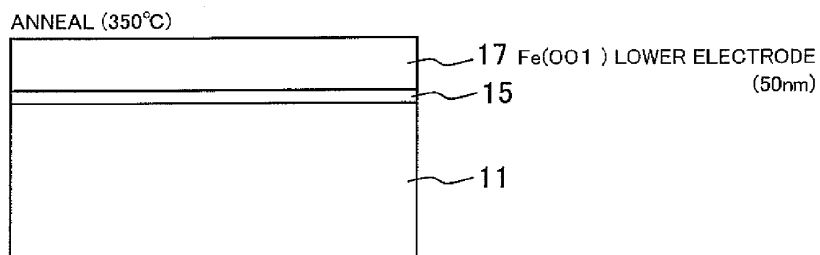


FIG. 2 (C)

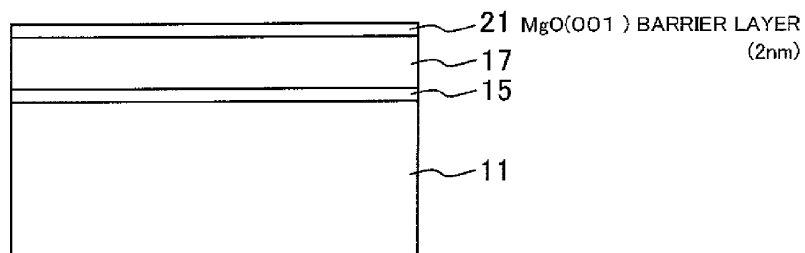


FIG. 2 (D)

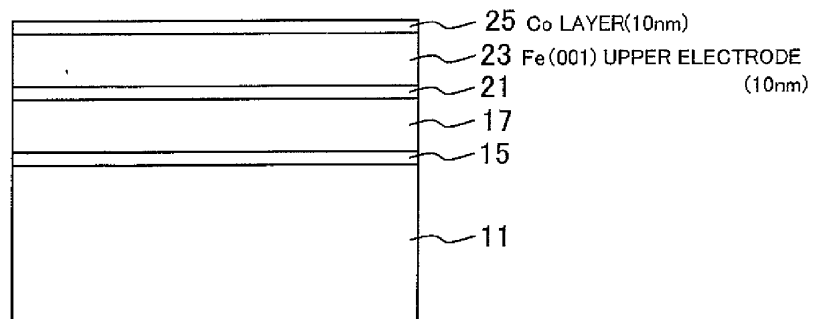


FIG. 3 (A)

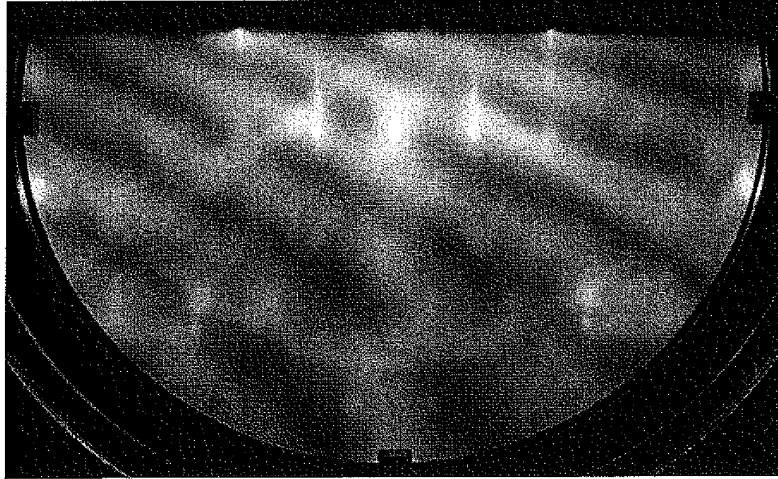


FIG. 3 (B)

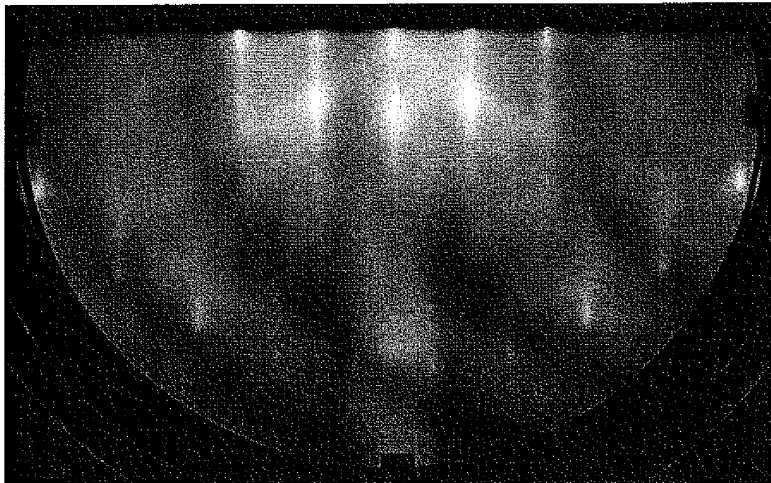


FIG. 4

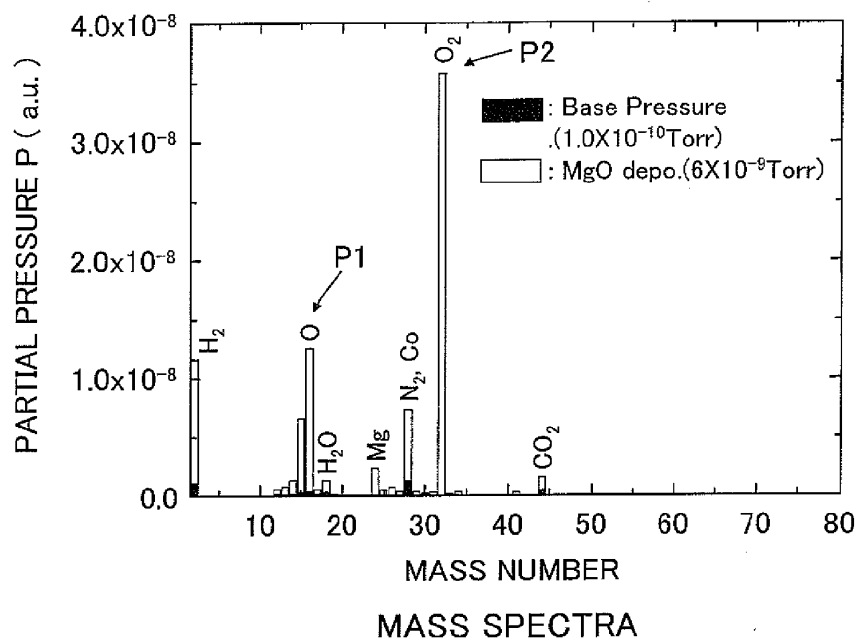


FIG. 5

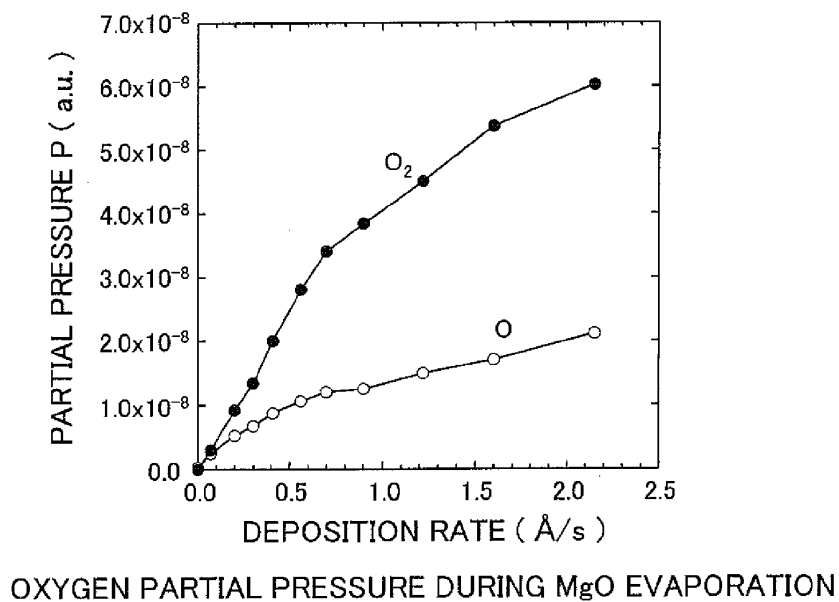


FIG. 6

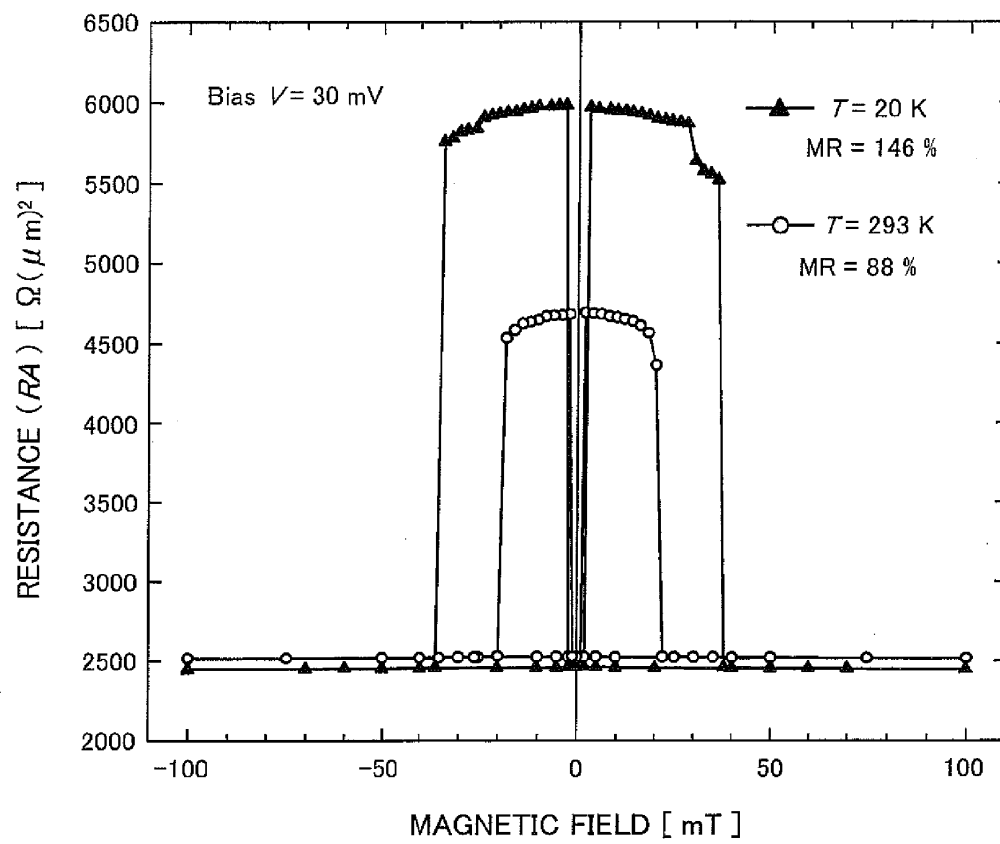


FIG. 7 (A)

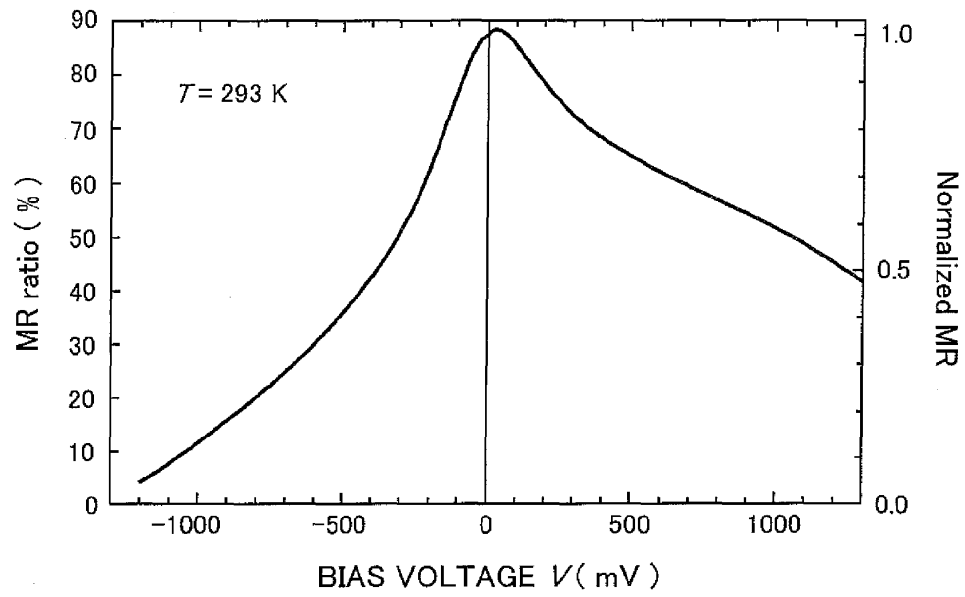


FIG. 7 (B)

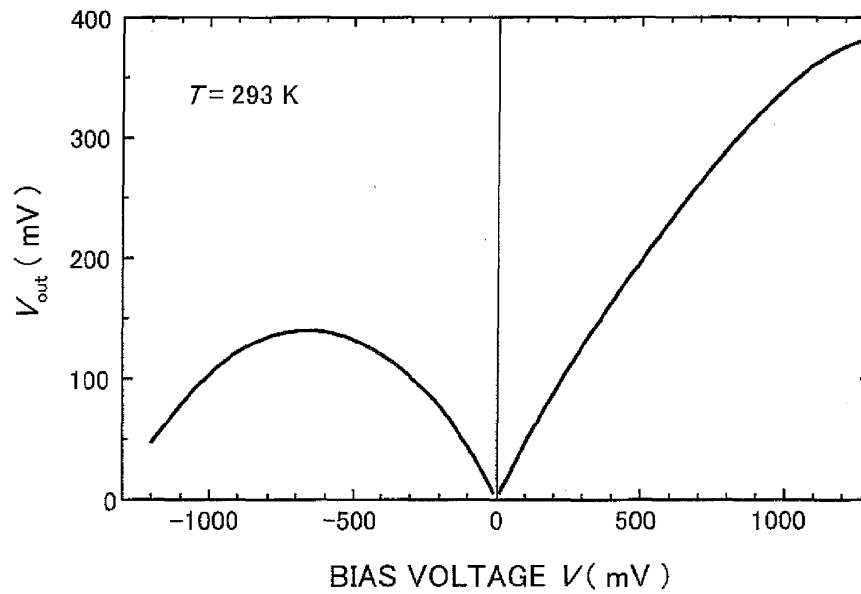


FIG. 8 (A)

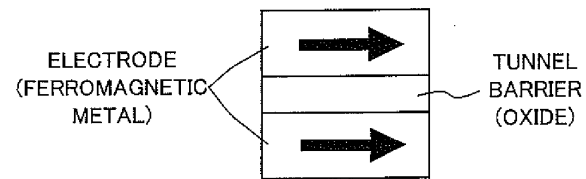


FIG. 8 (B)

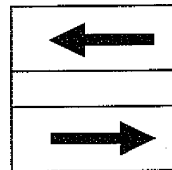


FIG. 9 (A)

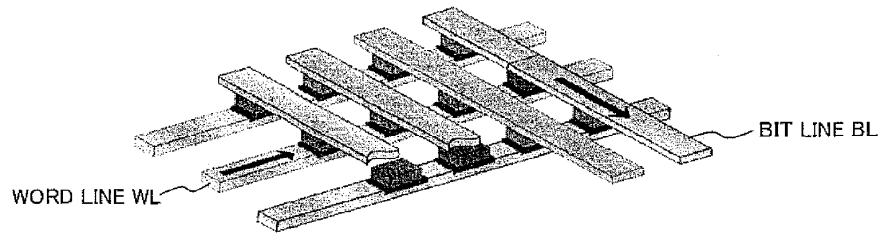


FIG. 9 (B)

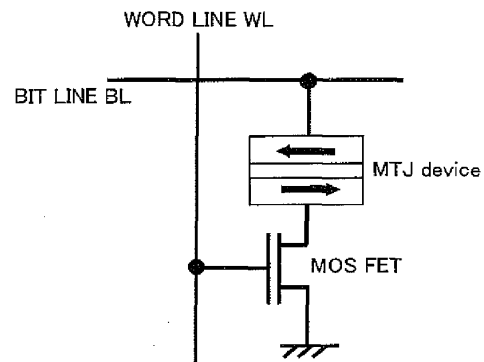


FIG. 9 (C)

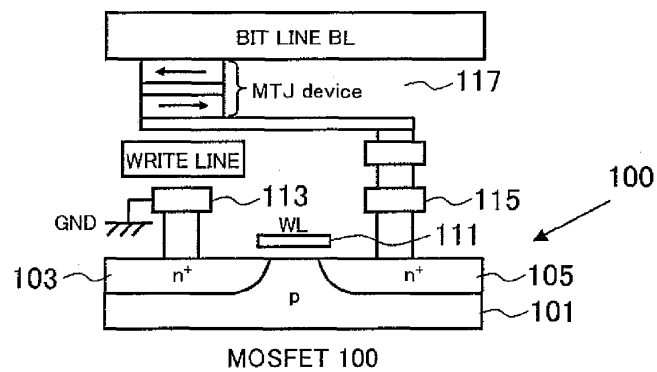


FIG. 10

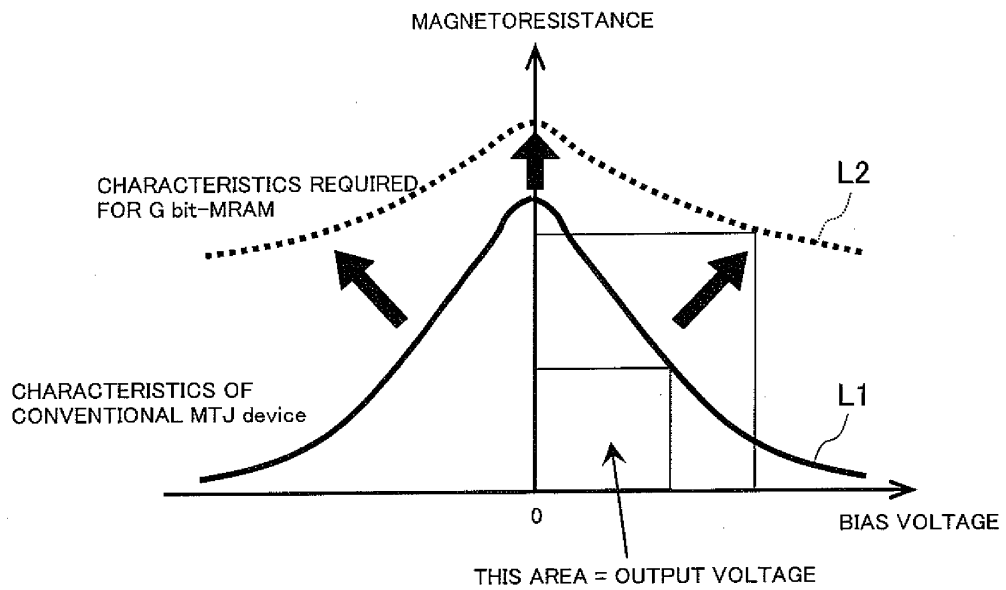
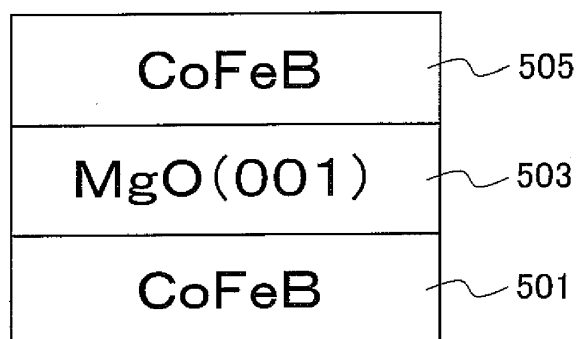


FIG. 11



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/004720

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. ⁷ H01L43/08, H01F10/32, H01L27/105, 43/10, 43/12		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) Int.Cl. ⁷ H01L43/08, H01F10/32, H01L27/105, 43/10, 43/12		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2005 Kokai Jitsuyo Shinan Koho 1971-2005 Toroku Jitsuyo Shinan Koho 1994-2005		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Science Citation Index Expanded (Web of Science)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 2003-318465 A (National Institute of Advanced Industrial Science and Technology), 07 November, 2003 (07.11.03), Full text & WO 2002/099905 A1 & US 2004/318465 A1 & EP 1391942 A1	1, 2, 8-10 3-7, 11, 15-20 12-14, 21, 22
Y A	JP 2002-204004 A (Toshiba Corp.), 19 July, 2002 (19.07.02), Par. No. [0035] (Family: none)	3-7, 11, 15-20 12-14, 21, 22
Y A	JP 2002-289943 A (Toshiba Corp.), 04 October, 2002 (04.10.02), Par. No. [0059] (Family: none)	3-7, 11, 15-20 12-14, 21, 22
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 08 June, 2005 (08.06.05)		Date of mailing of the international search report 21 June, 2005 (21.06.05)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/004720

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2003-204010 A (Sony Corp.), 24 October, 2003 (24.10.03), Par. Nos. [0029] to [0031] & WO 2003/085750 A1	15-20 21, 22

Form PCT/ISA/210 (continuation of second sheet) (January 2004)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Non-patent literature cited in the description

- **D. WANG et al.** *Science*, 2001, vol. 294, 1488 [0005]
- **W. WULFHEKEL et al.** *Appl. Phys. Lett.*, 2001, vol. 78, 509 [0015]
- **J. G. SIMMONS.** *J. Appl. Phys.*, 1963, vol. 34, 1793-1803 [0024]

<i>Index of Claims</i> 	Application/Control No. 11350226	Applicant(s)/Patent Under Reexamination GILL, HARDAYAL SINGH
	Examiner JOSE R DIAZ	Art Unit 2815

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant
 ☐ CPA
 ☐ T.D.
 ☐ R.1.47

CLAIM		DATE								
Final	Original	06/08/2009	10/08/2009	01/02/2010						
	1	✓	-	-						
	2	✓	✓	✓						
	3	✓	✓	✓						
	4	✓	✓	✓						
	5	✓	✓	✓						
	6	✓	✓	✓						
	7	✓	✓	✓						
	8	✓	✓	✓						
	9	✓	✓	✓						
	10	✓	✓	✓						
	11	✓	✓	-						
	12	✓	✓	✓						
	13	✓	✓	✓						
	14	✓	✓	✓						
	15	✓	✓	✓						
	16	N	N	N						
	17	N	N	N						
	18	N	N	N						
	19	N	N	N						
	20	N	N	N						

Search Notes 	Application/Control No. 11350226	Applicant(s)/Patent Under Reexamination GILL, HARDAYAL SINGH
	Examiner JOSE R DIAZ	Art Unit 2815

SEARCHED			
Class	Subclass	Date	Examiner
257	29,E21.208	6/8/09	JRD

SEARCH NOTES		
Search Notes	Date	Examiner
Text Search EAs. See search history printout. 257/295; 360/324.2	6/08/09	JRD
Text Search EAs. See search history printout.	10/8/09	JRD
Text Search EAs. See search history printout.	1/2/09	JRD

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

--	--

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	6	((("7,259,942") or ("20060256484") or ("6,671,141")).PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2010/01/02 10:55
L2	8	((("7,259,942") or ("20060256484") or ("6,671,141") or ("7453084")).PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2010/01/02 10:57
L3	1183	(mgo or (magnesium near oxide)) near5 barrier	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/01/02 11:42
L4	14	emitter and collector and 3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/01/02 11:43
L5	2	("20070183100").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2010/01/02 11:43
L6	666	(mtt or magnetic or mtj) and 3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/01/02 11:59
L7	292	(mtt or mtj) and 3	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/01/02 12:08

L8	94	7 not (@ad>"20060208" or @rlad>"20060208")	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/01/02 12:09
L9	10	mtj near3 mtt	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/01/02 13:49
L10	6	("1737055").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2010/01/02 14:46

EAST Search History (I nterference)

< This search history is empty >

1 / 2 / 10 2:57:11 PM

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Applicant: Gill	)	Art Unit: 2815
	)	
Serial No.: 11/350,226	)	Examiner: Diaz
	)	
Filed: February 8, 2006	)	HSJ920050318US1
	)	
For: MAGNETIC TUNNEL TRANSISTOR WITH THIN	)	January 28, 2010
READ GAP FOR HEAD APPLICATIONS	)	750 B STREET, Suite 3120
	)	San Diego, CA 92101
	)	

APPEAL BRIEF

Commissioner of Patents and Trademarks

Dear Sir:

This brief is submitted under 35 U.S.C. §134 and is in accordance with 37 C.F.R. Parts 1, 5, 10, 11, and 41, effective September 13, 2004 and published at 69 Fed. Reg. 155 (August 2004). This brief is further to Appellant's Notice of Appeal filed herewith.

Table of Contents

<u>Section Title</u>	<u>Page</u>	
(1) Real Party in Interest.....		2
(2) Related Appeals/Interferences.....		2
(3) Status of Claims.....		2
(4) Status of Amendments.....		2
(5) Summary of Claimed Subject Matter		2
(6) Grounds of Rejection to be Reviewed.....		3
(7) Argument.....		3
App.A Appealed Claims		
App.B Evidence Appendix		
App.C Related Proceedings Appendix		

(1) Real Party in Interest

The real party in interest is Hitachi Global Storage Technologies, Netherlands, B.V.

(2) Related Appeals/Interferences

No other appeals or interferences exist which relate to the present application or appeal.

(3) Status of Claims

Claims 2-10 and 12-15 are pending and finally rejected. Only the obviousness type double patenting rejections of Claims 2-10 and 12-15 are *not* appealed; all other rejections of these claims *are* appealed. Claims 1 and 11 are canceled. Claims 16-20 are withdrawn.

(4) Status of Amendments

No amendments are outstanding.

(5) Summary of Claimed Subject Matter

As an initial matter, it is noted that according to the Patent Office, the concise explanations under this section are for Board convenience, and do not supersede what the claims actually state, 69 Fed. Reg. 155 (August 2004), see page 49976. Accordingly, nothing in this Section should be construed as an estoppel that limits the actual claim language.

Claim 2 sets forth a magnetic tunnel transistor (MTT) which includes a ferromagnetic base (16, figure 2; page 4, line 13), a ferromagnetic emitter structure (20-24, figure 2; page 4, lines 18-22), and a ferromagnetic

collector (12, figure 2; page 4, line 10) that does not include GaAs (page 2, line 11). A barrier layer of TiO (14, figure 2; page 4, line 11) is disposed between the collector and the base.

Claim 8 recites a magnetic tunnel transistor (MTT) with a ferromagnetic base (16, figure 2; page 4, line 13), a ferromagnetic emitter structure (20-24, figure 2; page 4, lines 18-22), and a ferromagnetic collector (12, figure 2; page 4, line 10). A barrier layer (14, figure 2; page 4, line 11) is between the collector and base and has a barrier height of less than three-tenths of an electron volt. Also, a barrier layer of MgO (18, figure 2; page 4, line 14) is disposed between the base and the emitter structure.

(6) Ground of Rejection to be Reviewed on Appeal

(a) Claims 2-4 and 8-12 have been rejected under 35 U.S.C. §103 as being unpatentable over Nowak, USPN 7,453,084 in view of Lee (publication).

(b) Claims 5-7 and 13-15 have been rejected under 35 U.S.C. §103 as being unpatentable over Nowak in view of Lee and Sato, USPP 2006/0256484.

(7) Argument

Heading Corresponding to First Ground of Rejection, Claims 2-4 and 8-12

Subheading for Claim 2

The allegation on page 2 of the Office Action that Nowak, figure 1 and col. 5, lines 7-9 teaches that the collector does not have GaAs is clear factual error. The relied-upon section of Nowak teaches that the collector need not be made from a single-crystal semiconductor, and says nothing about GaAs. While one form of GaAs may be epitaxially-grown single crystals, alloys also may be made from GaAs and aluminum,

phosphorus, antimony, or indium. In other words, while some single crystals are GaAs, some combinations of GaAs are in alloys, meaning that the tacit syllogism underpinning the rejection is false. A teaching that a collector need not be made from a single crystal semiconductor is not the same thing as a teaching that the collector does not include GaAs. Claim 2 and its dependent claims are patentable.

This has been responded to on page 7 of the Office Action with a transparently false syllogism, namely, that because Nowak discloses a metal collector and since "GaAs is not a metal material, the collector in Nowak does not include GaAs". The flaw in this logic is the assumed but technically incorrect condition precedent of the major premise that nothing made of metal may contain GaAs. The examiner provides no evidence for his unstated assumption but Appellant herewith provides the publication listed in Appendix B which plainly indicates that GaAs may indeed be incorporated into metallic structures. Because the rejection is based on clear factual error, it merits reversal.

Subheading for Claims 3, 8

The allegation on page 3 of the Office Action that Nowak, figure 1 and col. 3, lines 31-33 teach the limitation of Claim 3 (which also appears in Claim 8) that the base-emitter barrier is made of MgO is clear reversible error. The relied-upon portion of Nowak teaches that the emitter-base barrier 14 is made of metal oxide such as aluminum oxide and nowhere mentions that it is made of the specific compound claimed.

This has been responded to on page 7 of the Office Action that "Nowak makes obvious the claimed material since MgO is a metal oxide." This is clear legal error. It is axiomatic that a genus does not necessarily describe a species, *Impax Laboratories Inc. v. Aventis Pharmaceuticals Inc.*, 468 F.3d 1366 (Fed. Cir. 2006).

The examiner next resorts to WO 2005/0088745, now EP 1 737 0 55 as a teaching that using MgO as a barrier layer is well known, Office Action, page 7. However, reliance on this publication is clear legal error since it was not published in English until the European patent was published in December 2006, with the WO publication being in Japanese, *In re Hilmer*, 359 F.2d 859 (CCPA 1966) (discussed at MPEP §2136.03).

The examiner also resorts to USPP 2004/0229430 for the same purpose, Office Action, page 7, but unfortunately for the examiner's case the discussion in this published application was directed to MJTs, not MTTs. The two structures are different and no evidence has been adduced of record that using MgO as an unrelated barrier in a different semiconductor device than claimed was known by the skilled artisan to encompass use as a different barrier layer in a different type of device.

As if to make Appellant's case, on page 8 of the Office Action the examiner thoughtfully refers to USPP 2008/0138660 as a teaching that a MTT device is merely a MJT device "married" to a collector, relying on paragraph 112. But what has escaped the examiner's attention is the explicit and unambiguous teaching in that paragraph that the MTT device envisioned MTT "is a three terminal device typically formed from a magnetic tunnel junction married to a *semiconductor collector where the semiconductor can be formed from, for example, GaAs*" (emphasis mine) - a structure that has been positively eliminated from Claim 3 by virtue of its dependency from Claim 2. The examiner's own evidence thus supplies yet another basis for reversal of a clearly erroneous rejection.

Heading Corresponding to Second Ground of Rejection, Claims 5-7 and 13-15

Subheading for Claims 5 and 13

The allegation that the CoFeB pinned layer 13 of the ferromagnetic tunnel junction device for a read head of Sato may be combined with Nowak and Lee to arrive at Claim 5 (the base of a magnetic tunnel

transistor being made of CoFeB) is clear error. Nowhere does Sato even mention the concepts of a base or emitter or collector; it is not directed to an MTT, but rather to a ferromagnetic junction device. There is thus no suggestion that its layer 13 be used in a structure which is not contemplated by Sato.

The examiner's response to this on page 8 of the Office Action is to refer to USPP 2008/0138660 as a teaching that a MTT device is merely a MJT device "married" to a collector, relying on paragraph 112. But what has escaped the examiner is the explicit and unambiguous teaching in that paragraph that the MTT device envisioned MTT "is a three terminal device typically formed from a magnetic tunnel junction married to a *semiconductor collector where the semiconductor can be formed from, for example, GaAs*" (emphasis mine) - a structure that has been positively eliminated from Claims 5-7 by virtue of their dependency from Claim 2. The examiner's own evidence thus supplies yet another basis for reversal of a clearly erroneous rejection.

In addition, the prior examiner made a finding of fact on the written record that the elected claims were patentably distinct from the non-elected claims because the elected claims have "separate utility such as usable in a memory as opposed to a read head". However, the present examiner's use of Sato in the present rejection diametrically contradicts the basis for the restriction, see, e.g., the title of Sato. Accordingly, it is respectfully submitted that for consistency, the restriction requirement be withdrawn and the non-elected claims be rejoined and allowed, or that Sato be removed as a reference.

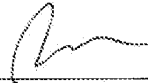
Subheading for Claims 6, 7, 14, and 15

The same comments apply to the rejections of Claims 6 and 7 (reciting specific emitter structure) based on teachings from Sato. Sato nowhere suggests that the relied-upon constituents should be used, much less would work with, MTTs.

CASE NO.: HSJ920050318US1
Serial No.: 11/350,226
January 28, 2010
Page 7

PATENT
Filed: February 8, 2006

Respectfully submitted,



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Attorney of Record
750 B Street, Suite 3120
San Diego, CA 92101
Telephone: (619) 338-8075

JLR:jg

1189-63APP

APPENDIX A - APPEALED CLAIMS

2. A magnetic tunnel transistor (MTT) comprising:
a ferromagnetic base;
a ferromagnetic emitter structure;
a ferromagnetic collector that does not include GaAs; and
a barrier layer of TiO disposed between the collector and the base.
3. The MTT of Claim 2, comprising a barrier layer of MgO disposed between the base and the emitter structure.
4. The MTT of Claim 2, wherein the collector is made of NiFe and/or CoFe.
5. The MTT of Claim 2, wherein the base is made of CoFeB.
6. The MTT of Claim 2, wherein the emitter structure includes a layer of Ru disposed between a layer of CoFeB and a layer of CoFe.
7. The MTT of Claim 6, wherein the emitter structure is pinned by a pinning layer.
8. A magnetic tunnel transistor (MTT) comprising:

a ferromagnetic base;
a ferromagnetic emitter structure;
a ferromagnetic collector;
a barrier layer between the collector and base and having a barrier height of less than three-tenths of an electron volt; and

a barrier layer of MgO disposed between the base and the emitter structure.

9. The MTT of Claim 8, wherein the barrier layer is made of TiO.
10. The MTT of Claim 9, wherein the collector does not include GaAs.
12. The MTT of Claim 9, wherein the collector is made of NiFe and/or CoFe.
13. The MTT of Claim 9, wherein the base is made of CoFeB.
14. The MTT of Claim 9, wherein the emitter structure includes a layer of Ru disposed between a layer of CoFeB and a layer of CoFe.
15. The MTT of Claim 14, wherein the emitter structure is pinned by a pinning layer.

CASE NO.: HSI920050318US1
Serial No.: 11/350,226
January 28, 2010
Page 10

PATENT
Filed: February 8, 2006

APPENDIX B - EVIDENCE

Publication "About the 8th Biennial Workshop on OMVPE: Technical Program", April 1997.

1189-63APP

About the 8th Biennial Workshop on OMVPE: Technical Program, Tuesday Afternoon Sessions (April 15)

TMS

8TH BIENNIAL WORKSHOP ON ORGANOMETALLIC VAPOR PHASE EPITAXY
April 13-17, 1997 • Dana Point, California

The following papers will be presented at the 8th Biennial Workshop on OMVPE, on Tuesday evening, April 15th, 1997. The [calendar of events](#) describes the entire technical program.

SESSION CHAIR:	
D.K. Gaskill, Naval Research Laboratory, Washington, DC	
Previous Session	Next Session

SESSION VI: GROWTH MECHANISMS & ORDERING

7:20 pm

Impurity Incorporation and the Surface Morphology of MOVPE Grown GaAs: *Jiang Li* and T.F. Kuech, Department of Chemical Engineering, University of Wisconsin, 1415 Engineering Drive, Madison, WI 53706

A comprehensive study of impurity incorporation in GaAs in metal-organic vapor phase epitaxy (MOVPE) process, combining growth, electrical and morphological studies, is presented. The impact of impurity incorporation on the development of surface morphology has been systematically investigated. According to our investigation the surface morphology of the epilayers was determined by both the properties of the impurity itself and the surface growth chemistry. A variety of different doping materials including Mg, Zn, C, Si, O and Se, were used to study the influence of the interaction between the impurity atoms and the host material on the surface morphology. Impurity atoms with smaller atomic weight belonging to group II and VI has a larger influence on the surface morphology than the other doping materials. Different doping sources for the same dopant were also used to explore the effect of surface growth chemistry on the formation of surface feature. The surface adsorbed methyl group can impede the lateral motion of surface steps thus lead to the modification of surface features. Models for impact of impurity on the growth front evolution based on surface chemistry are presented.

7:40 pm

Growth of Order/Disorder Heterostructures in GaInP using a Variation in the V/III Ratio: *Y.S. Chun**, S.H. Lee*, I.H. Ho*, G.B. Stringfellow*, C.E. Inglefield**, M.C. DeLong**, P.C. Taylor**, J.H. Kim***, and T.Y. Seong***, *Department of Materials Science and Engineering and Electrical Engineering, and **Departments of Physics, University of Utah, Salt Lake City, UT 84112, ***Departments of Materials Science and Engineering, Kwangju Institute of Science and Technology, Kwangju, Korea

CuPt ordering is known to result in a shrinkage of the bandgap of GaInP lattice matched to nominally

CASE NO.: HSI920050318US1
Serial No.: 11/350,226
January 28, 2010
Page 11

PATENT
Filed: February 8, 2006

APPENDIX C - RELATED PROCEEDINGS

None (this sheet made necessary by 69 Fed. Reg. 155 (August 2004), page 49978.)

1186-63APP

Electronic Patent Application Fee Transmittal				
Application Number:		11350226		
Filing Date:		08-Feb-2006		
Title of Invention:		Magnetic tunnel transistor with thin read gap for head applications		
First Named Inventor/Applicant Name:		Hardayal Singh Gill		
Filer:		John L. Rogitz/Jennifer Grygiel		
Attorney Docket Number:		HSJ920050318US1		
Filed as Large Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Notice of appeal	1401	1	540	540
Filing a brief in support of an appeal	1402	1	540	540
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1080

Electronic Acknowledgement Receipt	
EFS ID:	6940070
Application Number:	11350226
International Application Number:	
Confirmation Number:	9816
Title of Invention:	Magnetic tunnel transistor with thin read gap for head applications
First Named Inventor/Applicant Name:	Hardayal Singh Gill
Customer Number:	24955
Filer:	John L. Rogitz/Jennifer Grygiel
Filer Authorized By:	John L. Rogitz
Attorney Docket Number:	HSJ920050318US1
Receipt Date:	03-FEB-2010
Filing Date:	08-FEB-2006
Time Stamp:	14:27:19
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$1080
RAM confirmation Number	622
Deposit Account	502587
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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1	Notice of Appeal Filed	HSJ920050318US1_NoticeofAppeal.pdf	164771 b51636ea63ab608bb3e0f8a850fe4f2015335dfa	no	1
Warnings:					
Information:					
2	Appeal Brief Filed	HSJ920050318US1_AppealBrief.pdf	2976647 9e9246bddf34aa7b2c0a704579d9dcfcb0e5e15d	no	12
Warnings:					
Information:					
3	Fee Worksheet (PTO-875)	fee-info.pdf	31477 df357a8ccdf975f7cc0f2b9868152ded359b5c12c	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			3172895		
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Applicant: Gill	)	Art Unit: 2815
	)	
Serial No.: 11/350,226	)	Examiner: Diaz
	)	
Filed: February 8, 2006	)	HSJ920050318US1
	)	
For: MAGNETIC TUNNEL TRANSISTOR WITH THIN	)	January 28, 2010
READ GAP FOR HEAD APPLICATIONS	)	750 B STREET, Suite 3120
	)	San Diego, CA 92101
	)	

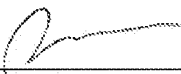
NOTICE OF APPEAL

Commissioner of Patents and Trademarks

Dear Sir:

The office action dated January 6, 2010 is hereby appealed.

Respectfully submitted,



John L. Rogitz
Registration No. 33,549
Attorney of Record
750 B Street, Suite 3120
San Diego, CA 92101
Telephone: (619) 338-8075

JLR:jg

1159-63NAP



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/350,226	02/08/2006	Hardayal Singh Gill	HSJ920050318US1	9816
24955 7590 08/03/2010 ROGITZ & ASSOCIATES 750 B STREET SUITE 3120 SAN DIEGO, CA 92101			EXAMINER DIAZ, JOSE R	
			ART UNIT 2815	PAPER NUMBER
			MAIL DATE 08/03/2010	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	11/350,226	GILL, HARDAYAL SINGH	
	Examiner	Art Unit	
	JOSE R. DIAZ	2815	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on 03 February 2010.

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) 2-10 and 12-20 is/are pending in the application.

4a) Of the above claim(s) 16-20 is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) 2-5, 8-10, 12 and 13 is/are rejected.

7) ☒ Claim(s) 6, 7, 14 and 15 is/are objected to.

8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☐ All b) ☐ Some * c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. _____.

3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892) 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.	4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____. 5) ☐ Notice of Informal Patent Application 6) ☐ Other: _____.
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DETAILED ACTION

1. In view of the appeal brief filed on February 3, 2010, PROSECUTION IS HEREBY REOPENED. New grounds of rejection are set forth below.

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) initiate a new appeal by filing a notice of appeal under 37 CFR 41.31 followed by an appeal brief under 37 CFR 41.37. The previously paid notice of appeal fee and appeal brief fee can be applied to the new appeal. If, however, the appeal fees set forth in 37 CFR 41.20 have been increased since they were previously paid, then appellant must pay the difference between the increased fees and the amount previously paid.

A Supervisory Patent Examiner (SPE) has approved of reopening prosecution by signing below:

***.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 2 and 4 are rejected under 35 U.S.C. 103(a) as being obvious over Nowak et al. (US 7,453,084 B2) in view of Lee et al. ("Large Magnetocurrents in

Double-barrier Tunneling Transistors”, Journal of Magnetism and Magnetic Materials, Feb. 2005, vol. 286, p.138-41).

Regarding claim 2, Nowak discloses a magnetic tunnel transistor (MTT) comprising:

a ferromagnetic base (16/38) [Figs. 1 and 2];

an ferromagnetic emitter structure (32) [Fig. 2; and col. 4, lines 29-30 and 58-65];

and

a collector (20/40) [Figs. 1 and 2]

a barrier layer of TiO (18/38) disposed between the collector and the base [Figs. 1 and 2; col. 3, lines 65-67 and col. 4, lines 21-27 and 54-55].

With regards to the limitation that the collector “does not include GaAs”, Nowak discloses the collector is made of metal instead of a semiconductor material [col. 3, lines 33-34 and col. 5, lines 7-10]. Thus, Nowak discloses the limitation since GaAs is a semiconductor material, not a metal.

Nowak substantially discloses the claimed invention except for a configuration having a ferromagnetic emitter, a ferromagnetic base and a ferromagnetic collector.

Lee teaches a structure having a ferromagnetic emitter, a ferromagnetic base and a ferromagnetic collector [Fig. 1; abstract and Section 3, first paragraph].

Nowak and Lee are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include ferromagnetic layers serving as the emitter, base and collector in the device as taught by Nowak. The motivation for doing so, as is taught by Lee, is increase the collector current density (abstract). In addition, the court has held that it is within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416 (CCPA 1960); *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). Therefore, it would have been obvious to combine Lee with Nowak to obtain the invention of claims 2 and 4.

Regarding claim 4, Lee teaches a ferromagnetic collector made of CoFe [Fig. 1 and Section 3, first paragraph].

4. Claims 3, 5, 8-10 and 12-13 are rejected under 35 U.S.C. 103(a) as being obvious over Nowak et al. (US 7,453,084 B2) in view of Lee et al. ("Large Magnetocurrents in Double-barrier Tunneling Transistors", *Journal of Magnetism and Magnetic Materials*, Feb. 2005, vol. 286, p.138-41), and further in view of Sato et al. (US 2006/0256484 A1).

Regarding claim 3, Nowak discloses a barrier layer (14/34) disposed between the base and the emitter structure [Fig. 1 and 2]. Further, Nowak discloses a barrier layer

made of a metal oxide such as aluminum oxide [col. 3, lines 31-32]. However, Nowak does not teach a barrier layer made of MgO.

Sato further teaches MgO as an alternative barrier material to aluminum oxide [paragraph 0062].

Nowak, Lee and Sato are analogous art because they are from the same field of endeavor as applicant's invention. At the time of the invention it would have been obvious to a person of ordinary skill in the art to include a Emitter-Base barrier layer made of MgO in the device taught by Nowak. The motivation for further doing so is that the substitution of one known element for another yields predictable results to one of ordinary skill in the art. In addition, the court has held that it is within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416 (CCPA 1960); *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). Therefore, it would have been obvious to combine Sato with Nowak and Lee to obtain the invention of claim 3.

Regarding claims 5 and 13, Nowak discloses a base made of CoFe [col. 3, lines 61-63]. Sato further teaches adding an additive element such as B to the CoFe material. [Paragraph 0054, 0062, and 0066]. The motivation for further doing so, as is taught by Sato is to improve the quality of the tunnel barrier film [paragraph 0066]. In addition, the court has held that it is within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416 (CCPA 1960); *Sinclair & Carroll Co. v.*

Interchemical Corp., 325 U.S. 327, 65 USPQ 297 (1945). Therefore, it would have been obvious to combine Sato with Nowak and Lee to obtain the invention of claims 5 and 13.

Regarding claims 8-9, Nowak and Lee, as stated in the rejection of claim 2, discloses the claimed invention including a barrier layer (18/38) disposed between the collector and the base [Figs. 1 and 2; col. 3, lines 65-67 and col. 4, lines 21-27 and 54-55]. In addition, Nowak discloses a barrier layer (14/34) disposed between the base and the emitter structure [Fig. 1 and 2]; and Sato, as stated in the rejection of claim 3, discloses MgO as the barrier material [Paragraph 0062]. With regards to the limitation of having a that the collector-base barrier has a barrier height of less than three-tenths of an electron volt, Nowak discloses a barrier layer made of TiO [Fig. 1 and col. 3, lines 65-67 and col. 4, lines 21-22 and 25-27].

Regarding claims 10 and 12, Nowak discloses a collector made of metal instead of a semiconductor material [col. 3, lines 33-34 and col. 5, lines 7-10]. In addition, Lee teaches a collector made of CoFe [Fig. 1].

Allowable Subject Matter

5. Claims 6-7 and 14-15 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

6. Applicant's arguments filed October 20, 2009 have been fully considered but they are not persuasive.

With regards to claims 1 and 10, applicant argued that the reference fail to teach the limitation "the collector that does not include GaAs". However, the examiner disagrees. For instance, Nowak discloses a collector 20 made of metal (col. 3, lines 33-34). Since GaAs is not a metal material, the collector in Nowak "does not include GaAs". In addition, Lee further teaches CoFe as the collector material [Fig. 1]. Therefore, the combination of Nowak and Lee renders the argued limitation obvious. As such the rejection is considered to be proper.

With regards to claims 3 and 8, a new rejection has been made in view of Sato to clarify that a barrier layer made of MgO is very well known in the art.

With regards to claims 5 and 13, a new rejection has been made in view of Sato to clarify that it is not novel to add an additive element such as B to a CoFe material.

Correspondence

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOSE R. DIAZ whose telephone number is (571)272-1727. The examiner can normally be reached on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2815

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/KENNETH A PARKER/
Supervisory Patent Examiner, Art Unit 2815

/J. R. D./
Examiner, Art Unit 2815

<i>Index of Claims</i> 	Application/Control No. 11350226	Applicant(s)/Patent Under Reexamination GILL, HARDAYAL SINGH
	Examiner JOSE R DIAZ	Art Unit 2815

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant
 ☐ CPA
 ☐ T.D.
 ☐ R.1.47

CLAIM		DATE							
Final	Original	06/08/2009	10/08/2009	01/02/2010	07/29/2010				
	1	✓	-	-	-				
	2	✓	✓	✓	✓				
	3	✓	✓	✓	✓				
	4	✓	✓	✓	✓				
	5	✓	✓	✓	✓				
	6	✓	✓	✓	O				
	7	✓	✓	✓	O				
	8	✓	✓	✓	✓				
	9	✓	✓	✓	✓				
	10	✓	✓	✓	✓				
	11	✓	✓	-	-				
	12	✓	✓	✓	✓				
	13	✓	✓	✓	✓				
	14	✓	✓	✓	O				
	15	✓	✓	✓	O				
	16	N	N	N	N				
	17	N	N	N	N				
	18	N	N	N	N				
	19	N	N	N	N				
	20	N	N	N	N				

Search Notes 	Application/Control No. 11350226	Applicant(s)/Patent Under Reexamination GILL, HARDAYAL SINGH
	Examiner JOSE R DIAZ	Art Unit 2815

SEARCHED			
Class	Subclass	Date	Examiner
257	29,E21.208	6/8/09	JRD
	updated	4/30/10	JRD

SEARCH NOTES		
Search Notes	Date	Examiner
Text Search EAs. See search history printout. 257/295; 360/324.2	6/08/09	JRD
Text Search EAs. See search history printout.	10/8/09	JRD
Text Search EAs. See search history printout.	1/2/09	JRD
Text Search EAs. See search history printout. 257/295; 360/324.2	4/30/10	JRD
Conferred with Ken Parker	4/27/10	JRD
Appeal Conference: Ken Parker and Jose Dees.	7/29/10	JRD

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
257	29,295,E21.208	4/30/10	JRD
360	324.2	4/30/10	JRD

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AUG 04 2010

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Applicant: Gill	)	Art Unit: 2815
	)	
Serial No.: 11/350,226	)	Examiner: Diaz
	)	
Filed: February 8, 2006	)	HSJ920050318US1
	)	
For: MAGNETIC TUNNEL TRANSISTOR WITH THIN	)	August 4, 2010
READ GAP FOR HEAD APPLICATIONS	)	750 B STREET, Suite 3120
	)	San Diego, CA 92101
	)	

RESPONSE TO OFFICE ACTION

Commissioner for Patents
Alexandria, VA

Dear Sir:

This responds to the Office Action dated August 3, 2010, indicating the allowability of Claims 6, 7, 14, and 15.

Respectfully submitted,

/John L. Rogitz/

John L. Rogitz
Registration No. 33,549
Attorney of Record
750 B Street, Suite 3120
San Diego, CA 92101
Telephone: (619) 338-8075

JLR:jg

1189-63AM2

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AUG 04 2010

CASE NO.: HSJ920050318US1
Serial No.: 11/350,226
August 4, 2010
Page 2

PATENT
Filed: February 8, 2006

1 (canceled).

2. (currently amended) A magnetic tunnel transistor (MTT) comprising:
a ferromagnetic base;
a ferromagnetic emitter structure;
a ferromagnetic collector that does not include GaAs; and
a barrier layer of TiO disposed between the collector and the base, wherein the emitter structure includes a layer of Ru disposed between a layer of CoFeB and a layer of CoFe.

3. (original) The MTT of Claim 2, comprising a barrier layer of MgO disposed between the base and the emitter structure.

4. (original) The MTT of Claim 2, wherein the collector is made of NiFe and/or CoFe.

5. (original) The MTT of Claim 2, wherein the base is made of CoFeB.

6. (canceled).

7. (currently amended) The MTT of Claim [[6]] 1, wherein the emitter structure is pinned by a pinning layer.

1189-63AM2

CASE NO.: HSJ920050318US1

Serial No.: 11/350,226

August 4, 2010

Page 3

PATENT

Filed: February 8, 2006

8. (currently amended) A magnetic tunnel transistor (MTT) comprising:

a ferromagnetic base;

a ferromagnetic emitter structure;

a ferromagnetic collector;

a barrier layer between the collector and base and having a barrier height of less than three-tenths of an electron volt; and

a barrier layer of MgO disposed between the base and the emitter structure, wherein the emitter structure includes a layer of Ru disposed between a layer of CoFeB and a layer of CoFe.

9. (original) The MTT of Claim 8, wherein the barrier layer is made of TiO.

10. (currently amended) The MTT of Claim [[9]] 8, wherein the collector does not include GaAs.

11. (canceled).

12. (currently amended) The MTT of Claim [[9]] 8, wherein the collector is made of NiFe and/or CoFe.

13. (currently amended) The MTT of Claim [[9]] 8, wherein the base is made of CoFeB.

14. (canceled).

1189-63AM2

CASE NO.: HSJ920050318US1
Serial No.: 11/350,226
August 4, 2010
Page 4

PATENT
Filed: February 8, 2006

15. (currently amended) The MTT of Claim [[14]] 8, wherein the emitter structure is pinned by a pinning layer.

16-20 (canceled).

1189-63AM2

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875					Application or Docket Number 11/350,226		Filing Date 02/08/2006		☐ To be Mailed			
APPLICATION AS FILED – PART I												
(Column 1)			(Column 2)			SMALL ENTITY ☐ OR		OTHER THAN SMALL ENTITY				
FOR		NUMBER FILED	NUMBER EXTRA		RATE (\$)	FEE (\$)		RATE (\$)	FEE (\$)			
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))		N/A	N/A		N/A			N/A				
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))		N/A	N/A		N/A			N/A				
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))		N/A	N/A		N/A			N/A				
TOTAL CLAIMS (37 CFR 1.16(i))		minus 20 =	*		X \$ =		OR	X \$ =				
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 =	*		X \$ =			X \$ =				
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).										
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))												
* If the difference in column 1 is less than zero, enter "0" in column 2.												
APPLICATION AS AMENDED – PART II												
(Column 1)			(Column 2)			(Column 3)			SMALL ENTITY OR OTHER THAN SMALL ENTITY			
AMENDMENT	08/04/2010		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)		RATE (\$)	ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))		* 11	Minus	** 20	= 0	X \$ =		OR	X \$52=	0	
	Independent (37 CFR 1.16(h))		* 2	Minus	***3	= 0	X \$ =		OR	X \$220=	0	
	☐ Application Size Fee (37 CFR 1.16(s))											
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))											
	TOTAL ADD'L FEE											
TOTAL ADD'L FEE											0	
AMENDMENT			CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)		RATE (\$)	ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))		*	Minus	**	=	X \$ =		OR	X \$ =		
	Independent (37 CFR 1.16(h))		*	Minus	***	=	X \$ =		OR	X \$ =		
	☐ Application Size Fee (37 CFR 1.16(s))											
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))											
	TOTAL ADD'L FEE											
TOTAL ADD'L FEE												
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.												

Legal Instrument Examiner:
/Ruby Johnson/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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NOTICE OF ALLOWANCE AND FEE(S) DUE

24955 7590 08/19/2010

ROGITZ & ASSOCIATES
750 B STREET
SUITE 3120
SAN DIEGO, CA 92101

EXAMINER

DIAZ, JOSE R

ART UNIT

PAPER NUMBER

2815

DATE MAILED: 08/19/2010

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/350,226	02/08/2006	Hardayal Singh Gill	HSJ920050318US1	9816

TITLE OF INVENTION: MAGNETIC TUNNEL TRANSISTOR WITH THIN READ GAP FOR HEAD APPLICATIONS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1510	\$300	\$0	\$1810	11/19/2010

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

**Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885**

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

24955 7590 08/19/2010

ROGITZ & ASSOCIATES
750 B STREET
SUITE 3120
SAN DIEGO, CA 92101

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
-----------------	-------------	----------------------	---------------------	------------------

11/350,226 02/08/2006 Hardayal Singh Gill HSJ920050318US1 9816

TITLE OF INVENTION: MAGNETIC TUNNEL TRANSISTOR WITH THIN READ GAP FOR HEAD APPLICATIONS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
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nonprovisional NO \$1510 \$300 \$0 \$1810 11/19/2010

EXAMINER	ART UNIT	CLASS-SUBCLASS
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DIAZ, JOSE R 2815 257-029000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

- (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, 1 _____
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☐ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

- ☐ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/350,226	02/08/2006	Hardayal Singh Gill	HSJ920050318US1	9816
24955	7590	08/19/2010	EXAMINER	
ROGITZ & ASSOCIATES 750 B STREET SUITE 3120 SAN DIEGO, CA 92101			DIAZ, JOSE R	
			ART UNIT	PAPER NUMBER
			2815	
DATE MAILED: 08/19/2010				

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 772 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 772 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

REASONS FOR ALLOWANCE

1. The following is an examiner's statement of reasons for allowance: the prior art fails to teach, disclose, or suggest, either alone or in combination, a magnetic tunnel transistor comprising:

an emitter structure including a layer of Ru disposed between a layer of CoFeB and a layer of CoFe; and a barrier of TiO disposed between the collector and the base as instantly claimed, and in combination with the additional limitations; or

an emitter structure including a layer of Ru disposed between a layer of CoFeB and a layer of CoFe; and a barrier of MgO disposed between the base and the emitter structure as instantly claimed, and in combination with the additional limitations.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Correspondence

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOSE R. DIAZ whose telephone number is (571)272-1727. The examiner can normally be reached on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/J. R. D./
Examiner, Art Unit 2815
/KENNETH A PARKER/
Supervisory Patent Examiner, Art Unit 2815

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	3295	(257/295,29,E21.208). CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2010/08/11 08:17
L2	852	(360/324.2).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2010/08/11 08:17
L3	1179	(ru or ruthenium) and 1	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/08/11 08:18
L4	573	(ru or ruthenium) and 2	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/08/11 08:18
L5	5	3 and 4	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/08/11 08:18
L6	1747	3 or 4	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/08/11 08:18
L7	228	cofeb and 6	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/08/11 08:19

L8	637	cofe and 6	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/08/11 08:19
L9	210	7 and 8	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/08/11 08:19
L10	2	"20070183100"	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2010/08/11 08:20
L11	4	(("5465185") or ("6153320")).PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2010/08/11 08:37

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L12	5	(257/295,29, E21.208).CCLS.	UPAD	OR	OFF	2010/08/11 08:47
L13	5	(360/324.2).CCLS.	UPAD	OR	OFF	2010/08/11 08:47
L14	2	(ru or ruthenium) and 12	USPAT; UPAD	OR	ON	2010/08/11 08:47

8/ 11/ 10 9:07:50 AM

C:\ Documents and Settings\jdiaz\ My Documents\ EAST\ Workspaces\ 11350226.wsp

<i>Index of Claims</i> 	Application/Control No. 11350226	Applicant(s)/Patent Under Reexamination GILL, HARDAYAL SINGH
	Examiner JOSE R DIAZ	Art Unit 2815

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant
 ☐ CPA
 ☐ T.D.
 ☐ R.1.47

CLAIM		DATE							
Final	Original	06/08/2009	10/08/2009	01/02/2010	07/29/2010	08/11/2010			
	1	✓	-	-	-	-			
1	2	✓	✓	✓	✓	=			
2	3	✓	✓	✓	✓	=			
3	4	✓	✓	✓	✓	=			
4	5	✓	✓	✓	✓	=			
	6	✓	✓	✓	O	-			
5	7	✓	✓	✓	O	=			
6	8	✓	✓	✓	✓	=			
7	9	✓	✓	✓	✓	=			
8	10	✓	✓	✓	✓	=			
	11	✓	✓	-	-	-			
9	12	✓	✓	✓	✓	=			
10	13	✓	✓	✓	✓	=			
	14	✓	✓	✓	O	-			
11	15	✓	✓	✓	O	=			
	16	N	N	N	N	-			
	17	N	N	N	N	-			
	18	N	N	N	N	-			
	19	N	N	N	N	-			
	20	N	N	N	N	-			

Issue Classification 	Application/Control No. 11350226	Applicant(s)/Patent Under Reexamination GILL, HARDAYAL SINGH
	Examiner JOSE R DIAZ	Art Unit 2815

ORIGINAL						INTERNATIONAL CLASSIFICATION												
CLASS		SUBCLASS				CLAIMED					NON-CLAIMED							
257		29				H	0	1	L	29 / 08 (2006.01.01)								
CROSS REFERENCE(S)																		
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)																	
257	295	E21.208																
360	324.2																	

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47															
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	2														
2	3														
3	4														
4	5														
5	7														
6	8														
7	9														
8	10														
9	12														
10	13														
11	15														

/JOSE R DIAZ/ Examiner.Art Unit 2815 (Assistant Examiner)	8/11/10 (Date)	Total Claims Allowed: 11	
/KENNETH A PARKER/ Supervisory Patent Examiner.Art Unit 2815 (Primary Examiner)	08/15/2010 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 2

Search Notes 	Application/Control No. 11350226	Applicant(s)/Patent Under Reexamination GILL, HARDAYAL SINGH
	Examiner JOSE R DIAZ	Art Unit 2815

SEARCHED			
Class	Subclass	Date	Examiner
257	29,E21.208	6/8/09	JRD
	updated	4/30/10	JRD
	updated	8/11/10	JRD

SEARCH NOTES		
Search Notes	Date	Examiner
Text Search EAs. See search history printout. 257/295; 360/324.2	6/08/09	JRD
Text Search EAs. See search history printout.	10/8/09	JRD
Text Search EAs. See search history printout.	1/2/09	JRD
Text Search EAs. See search history printout. 257/295; 360/324.2	4/30/10	JRD
Conferred with Ken Parker	4/27/10	JRD
Appeal Conference: Ken Parker and Jose Dees.	7/29/10	JRD
Text Search EAs. See search history printout.	8/11/10	JRD

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
257	29,295,E21.208	4/30/10	JRD
360	324.2	4/30/10	JRD
	updated	8/11/10	JRD

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PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail** Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

24955 7590 08/19/2010

Rambod Nader
 Hitachi Global Storage Technologies
 3403 Yerba Buena Road
 San Jose CA 95135

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

Jennifer Grygiel	(Depositor's name)
/Jennifer Grygiel/	(Signature)
November 4, 2010	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/350,226	02/08/2006	Hardayal Singh Gill	HSJ920050318US1	9816

TITLE OF INVENTION: MAGNETIC TUNNEL TRANSISTOR WITH THIN READ GAP FOR HEAD APPLICATIONS

APPLN TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1510	\$300	\$0	\$1810	11/19/2010

EXAMINER	ART UNIT	CLASS-SUBCLASS
DIAZ, JOSE R	2815	257-029000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☒ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☒ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47, Rev 03-02, or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 John L. Rogitz

2

3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

Hitachi Global Storage Technologies
 Netherlands B.V.

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Amsterdam, The Netherlands

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

☒ Issue Fee

☒ Publication Fee (No small entity discount permitted)

☐ Advance Order - # of Copies

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

☐ A check is enclosed

☐ Payment by credit card. Form PTO-2038 is attached.

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number 50-2587 (enclose an extra copy of this form)

5. Change in Entity Status (from status indicated above)

☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant, a registered attorney or agent, or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature /John L. Rogitz/

Date November 4, 2010

Typed or printed name John L. Rogitz

Registration No. 33,549

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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"FEE ADDRESS" INDICATION FORM

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Alexandria, VA 22313-1450

Fax to:
571-273-6500

- OR -

INSTRUCTIONS: The issue fee must have been paid for application(s) listed on this form. In addition, only an address represented by a Customer Number can be established as the fee address for maintenance fee purposes (hereafter, fee address). A fee address should be established when correspondence related to maintenance fees should be mailed to a different address than the correspondence address for the application. **When to check the first box below:** If you have a Customer Number to represent the fee address. **When to check the second box below:** If you have no Customer Number representing the desired fee address, in which case a completed Request for Customer Number (PTO/SB/125) must be attached to this form. For more information on Customer Numbers, see the Manual of Patent Examining Procedure (MPEP) § 403.

For the following listed application(s), please recognize as the "Fee Address" under the provisions of 37 CFR 1.363 the address associated with:

☒ Customer Number: 36023

OR

☐ The attached Request for Customer Number (PTO/SB/125) form.

PATENT NUMBER (if known)	APPLICATION NUMBER
	11/350,226

Completed by (check one):

☐ Applicant/Inventor	/John L. Rogitz/ Signature
☒ Attorney or Agent of record <u>33,549</u> (Reg. No.)	<u>John L. Rogitz</u> Typed or printed name
☐ Assignee of record of the entire interest. See 37 CFR 3.71. Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)	<u>619.338.8075</u> Requester's telephone number
☐ Assignee recorded at Reel _____ Frame _____	<u>November 4, 2010</u> Date

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

☒ Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.363. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 5 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND COMPLETE D FORMS TO THIS ADDRESS. SEND TO: Mail Stop M Correspondence, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Patent Application Fee Transmittal				
Application Number:		11350226		
Filing Date:		08-Feb-2006		
Title of Invention:		MAGNETIC TUNNEL TRANSISTOR WITH THIN READ GAP FOR HEAD APPLICATIONS		
First Named Inventor/Applicant Name:		Hardayal Singh Gill		
Filer:		John L. Rogitz/Jennifer Grygiel		
Attorney Docket Number:		HSJ920050318US1		
Filed as Large Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl issue fee	1501	1	1510	1510
Publ. Fee- early, voluntary, or normal	1504	1	300	300

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1810

Electronic Acknowledgement Receipt	
EFS ID:	8771465
Application Number:	11350226
International Application Number:	
Confirmation Number:	9816
Title of Invention:	MAGNETIC TUNNEL TRANSISTOR WITH THIN READ GAP FOR HEAD APPLICATIONS
First Named Inventor/Applicant Name:	Hardayal Singh Gill
Customer Number:	24955
Filer:	John L. Rogitz/Jennifer Grygiel
Filer Authorized By:	John L. Rogitz
Attorney Docket Number:	HSJ920050318US1
Receipt Date:	04-NOV-2010
Filing Date:	08-FEB-2006
Time Stamp:	15:50:26
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$1810
RAM confirmation Number	2391
Deposit Account	502587
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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1	Issue Fee Payment (PTO-85B)	HSJ920050318US1_IssueFeeTransmittal.pdf	666433 9186aabc70ca53bcd0fe87f09150dbe965a3971	no	1
Warnings:					
Information:					
2	Change of Address	HSJ920050318US1_ChangeCorrespondenceAddress.pdf	393033 ee015792aeb3bf6b1dcf9b6a4e00179e8bcd0b0	no	1
Warnings:					
Information:					
3	Change of Address	HSJ920050318Us1_FeeAddress.pdf	473175 94d708a6b3c7540b926c09ebcc43af4f08579448	no	1
Warnings:					
Information:					
4	Fee Worksheet (PTO-875)	fee-info.pdf	32066 ecb75b7fe4ec01988193fdbca9854ec047d3b0cb	no	2
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CHANGE OF CORRESPONDENCE ADDRESS <i>Application</i>	Application Number	11350226
	Filing Date	2006-02-08
	First Named Inventor	Hardayal Singh Gill
	Art Unit	2815
	Examiner Name	Jose R. Diaz
	Attorney Docket Number	HSJ920050318US1

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Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

☒ Attorney or agent of record. Registration Number 33,549

☐ Registered practitioner named in the application transmittal letter in an application without an executed oath or declaration. See 37 CFR 1.33(a)(1). Registration Number _____

Signature /John L. Rogitz/

Typed or Printed Name John L. Rogitz

Date November 4, 2010 Telephone 619.338.8075

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below.

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Bib Data Sheet

CONFIRMATION NO. 9816

SERIAL NUMBER 11/350,226	FILING OR 371(c) DATE 02/08/2006 RULE	CLASS 257	GROUP ART UNIT 2815	ATTORNEY DOCKET NO. HSJ920050318US1
APPLICANTS Hardayal Singh Gill, Palo Alto, CA;				
** CONTINUING DATA *****				
** FOREIGN APPLICATIONS *****				
IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 03/07/2006				
Foreign Priority claimed ☐ yes ☐ no 35 USC 119 (a-d) conditions ☐ yes ☐ no ☐ Met after met Verified and Acknowledged <u>Examiner's Signature</u> <u>Initials</u>		STATE OR COUNTRY CA	SHEETS DRAWING 1	TOTAL CLAIMS 20
				INDEPENDENT CLAIMS 3
ADDRESS 36023				
TITLE MAGNETIC TUNNEL TRANSISTOR WITH THIN READ GAP FOR HEAD APPLICATIONS				
FILING FEE RECEIVED 1300	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:		☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit	



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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/350,226	12/14/2010	7851785	HSJ920050318US1	9816

36023 7590 11/23/2010
HITACHI GLOBAL STORAGE TECHNOLOGIES, INC.
5600 COTTLE ROAD, NHGB/0142
IP DEPARTMENT
SAN JOSE, CA 95193

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment is 1203 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

Hardayal Singh Gill, Palo Alto, CA;