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 (22) 2002 02 20

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(71) 가 가
 가 4 6

(72) 가 가 가 785

가 가 6 - 1

가 가 880

5 - 16 - 2 - 1

(74)

(54)

1
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14
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16 1
17 2
18 3
19 4
20 5
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25

10 :

101 :

11, 46 :

12 :

121 :

13 :

131 : 1

132 : 2

133 : 1

134 : 2

14 :

15 :

151 : 1

152 : 2

154 :

35 :

36 :

37 :

40 :

41 :

411 :

412 :

413 :

414 :

415 :

416 :

42 :

43 :

44 :

45 :

50 :

63 :

64 :

71 :

711 :

72 :

721 :

73 :

83 :

84 :

90 :

91 :

92 :

93 :

94 :

95 :

USP5408377

가

7 - 73416

MR 가

7 - 169026

() 가

10 - 173252

가

10 - 284768

가

11 - 259824

가

가

가

가

가

가

가

(specular effect)

Synthetic ferrimagnet

가

가

가

(magnetizing)

가

(magnetostatic energy)

, 0.2 0.1 μm 가

가

가

가

가

가

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가

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가

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(感磁)

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Fe_3O_4

, Fe, Ni, Mn, Co

Ni - 75 85Fe, Co -

1 12Fe, Co - 2 15Fe, 1 30Ni,
Si, Ge,

가

1nm

,

가

,

The figure shows a cross-sectional transmission electron microscopy (TEM) image of a multilayered structure. The layers are labeled from top to bottom as follows:

- MnIr (0.8 nm)
- Ru, Ir, Os, Re, Rh (0.9 nm)
- Co
- Co/Ru/Co (0.8 nm)
- Ru (2 nm)
- Ru/Ta (1 nm)
- Ru (0.8 nm)
- Cr (0.2 nm)

The MnIr layer is at the very top. Below it is a complex layer consisting of Ru, Ir, Os, Re, and Rh. This is followed by a single Co layer. The next layer is Co/Ru/Co, which is 0.8 nm thick. Below that is another Ru layer (2 nm). The Ru/Ta layer is 1 nm thick, followed by another Ru layer (0.8 nm). At the bottom is a thin Cr layer (0.2 nm). The overall thickness of the stack is approximately 10 nm.

80
MnPt 가 270, 3 MnPt
MnPt 가

가 . LLG(Landau Lifshitz Gilbert)

1 , (50) (35), (71)
, (10) (72), (36)
, (43) (40) (10)
, 가 (40)
, 가
(10) 1

(14), (11), (15), (12), (13)
 . , (15) 1 (151) 2 (152), (154)
 . (154) 1 (151) 2 (152)
 가 , 가 . , (15) 1 (151) 2 (152)
 . , . , (13) , (13) 1
 2 , (13) , (12) 가 2
 NiFe ,
 (10) (13) (411), (412), (413) , (37)
 (10)
 (13)
 , (37)

(411) (13) (412) (411), Ta 1nm
 Ru, Cu (411) (411)
 (412) (413) (412) (10) (13) 가

(45) , (10)
 , (412) (13) 가 , (13) (412)
 , (13) . (13) (412)
 가 가 , (13) (412) .
 가 (412) 가

(14),	(11),	(15),	(12),	(13)	
,	(15) 1		(151) 2	(152),	(154)
.	(154) 1	(151) 2	(152)		
가 ,			1	(151) 2	(152)
	가 . ,		(15)	, 2	4
			.		
2		,		(13)	
				(13) 1	2
				(12) 가	Co

NiFe
 ,
 (10) (13) (45)
 (10) (13) (411), (414) (37)
 45) (37)

(411) (13) (414)
, Ru, Cu (10) (411), Ta 1nm
, (411)
(10) (414) (414)
, 40kOe, 160kOe
(10) (10) (13) (45)
(13) 가 , (414)
(13) (13) (414) , 가 ,
, , , ,

(13) (414) 가 (414)
 (13) ,
 2 (414) ,
 , (15) ,
 ,
 3
 3
 1)
 (36)
 (10)
 40)
 ,
 .
 (14), (11), (15), (12), (13)
 . (15) 1 (151) 2 (152), (154)
 가 ,
 가 ,
 ,
 (151) 2 (152)
 1 (151) 2 (152)
 ,
 ,
 2 (13)
 ,
 NiFe (10) (13) (45)
 (10) (13) (411), (416), (415), (414) (45)
 , (37)
 ,
 ,
 (411) (13) (416)
 (411) (416) Ta 1nm
 , Ru, Cu (10) (414) (415)
 (414) (415) Ta,
 ,
 (411) (415)
 ,
 (13)
 ,
 (414) (416)
 40kOe (416) 160kOe (414)

(10) (13) (45), (10)
 (13) 가 , , (416), (414) 가
 (13) (13) . (13) , (13) , (416) (416) (414)
 (414) 가 가 , (13) 가 , (416) (416) (414)
 (13) (13) 가 (13) (13)

(14), (11), (15), (12), (13)
 . (15) 1 (151) 2 (152), (154)
 . (154) 1 (151) 2 (152)
 . 가 , . , (15) . , (151) 2 (152)
 . . , (13) . , (13) 1
 2 (13) . , (12) 가 , 2
 . NiFe ,
 . (10) , (13) (45) , (45)
 . (10) , (13) (411), (416), (415), (414)
 . (37) , (37)

(411) (13) (416) (411), Ta 1nm
 , Ru, Cu (411) 3 (415)
 (10) (416) (416) (415) (414)
 (416) (415) (416) (415) R
 u, Ir (416) (414)

(13)

(414) ,
 (414) (416) 40kOe , 160kOe (414)
 . (416) (10) (13) (45) , (414),
 . (10) (416) (13) 가 , , (13)
 , (416) , 가 (414) 가 (13) , (13) , (13)
 (414) (416) (414) (13) . 가 (414)
 (414) (416) (13) (13)

, 5 8

$$5 \quad (41) \quad (13) \quad , \quad (13) \quad 가$$

가 가 ,
가 LG 5

$$\text{가} \quad , \quad 7 \quad , \quad 7 \quad . \quad (13)$$

12 13

12
0.18 μm ,0.16 μm 0.1 μm

3

, ,

가

,

(12
가)

12

가

, 가

가

가

12 13
가 μm 0.2 μm (13
가)0.18 μm ,

0.16

가

가

14

1

가

14

가

MnPt MnIr

330

270

, 230

, MnIr

, MnPt

MnPt

, MnPt

15

10nm

5000

40kA

/m

1

(412)

, 2, 3, 4

(414),

3, 4

(416)

Fe

가

가

16 20

16 .
 1 .
 nPt 1nm, 2 (152) CoFe 1.5nm, (50) (14) Ta 3nm, NiFe 3nm, (11) M
 oFe 2.5nm, (12) Cu 2.1nm, 2 (154) Ru 0.8nm, 1 (151) C
 (131) NiFe 4nm, (411) (132) CoFe 0.5nm, 1
 e 3nm, (413) MnIr 7nm, (37) Ta 3nm .
 .

(151)	2	(152)	.	(10)	(154)	Ru	1	(151)	2	(154),	1
52)				가	,						1
(151)	2	(152)			가	.	,			(13)	1
	NiFe	2		CoFe		.		가	,		
(45)		(13)		(411),		(412),		(413)		(37)	
.		(411)			(10)					,	
(411)				.			(411)			(13)	
(45),		(412)									,
				(13)			(45),		(412)		
				(411)			2nm				.

17 .
 1 (50) (14) Ta 3nm, NiFe 3nm, (11) M
 nPt 12nm, 2 (152) CoFe 1.5nm, (154) Ru 0.8nm, 1 (151)
 CoFe 2.5nm, (12) Cu 2.1nm, 2 (132) CoFe 0.5nm, 1
 (131) NiFe 4nm, (411) Cu 1nm, Ta/Ta - O 1.0nm, (412) Co
 Fe/Al₂O₃ 6nm CoFe 1nm, (413) MnIr 7nm, (37) Ta 3nm

18
 2
 Pt 12nm, 2 (152)
 oFe 2.5nm, (12) CoFe 1.5nm, (5) (14) Ta 3nm, NiFe 3nm,
 (131) NiFe 4nm, Cu 2.1nm, 2 (154) Ru 0.8nm, 1 (11) Mn
 4) Fe₃O₄ 8nm, (37) Ta 3nm (151) C

 (151) 2 (152)
 52)
 (151) 2 (152)
 (45) NiFe 2
 (13) CoFe (411), (10) (414) (37) .
 (411)
 (13) (411) (45), (414)
 3O₄, (414) Fe

 19
 3
 (11) MnPt 12nm, 2 (152)
 (151) CoFe 2.5nm, (12) CoFe 1.5nm, (50) (14) Ta 3nm, NiFe 3nm,
 1 (131) NiFe 4nm, Cu 2.1nm, 2 (154) Ru 0.8nm, 1
 3nm, (416) CoFe 1nm, (415) Al₂O₃ 1nm, (132) CoFe 0.5nm,
 Cu 1nm, Ta/Ta-O 1.0nm Al₂O₃ 1nm, (414) Fe₃O₄ 8nm

 (151) 2 (152)
 52)
 (151) 2 (152)
 (45) NiFe 2
 (13) CoFe (411), (10) (416), (415), (414)
 (411)
 (45), (416) (13) (411)
 (414) Fe₃O₄, (416)

 (415) (414) (416)
 (414) (416) Al₂O₃
 u (415) R
 4

20
 1
 3nm, (413) NiMn 20nm, (412)
 Cu 1nm, 1 (131) NiFe 4nm, 2 (50) (14) Ta 3nm, NiFe
 (132) CoFe 0.5nm, (411) Ru 0.4nm

(12) Cu 2.1nm, 1 (151) CoFe 2.5nm, (154) Ru 0.8nm, 2 (152) CoFe 1.5nm, (11) MnPt 12nm, (37) Ta 3nm

(151)	2	(152)	.	(10)	(154)	Ru	(15)	(154),	1
52)				가	,		1		
(151)	2	(152)			가	.	,		
		NiFe	2		CoFe	.	가	,	
(45)			(13)		(411),	(412),	(413)		(37)
.			(411)			(10)		,	
(411)					.		(411)		(13)
(45),		(412)							,
				(13)		(45),		(412)	
				(411)		1.4nm			.

21 ,
 21 (50) (35),
 (711) (101) (7)
 21), (36) (43) (73)
 (101) ,
 (101) (73) ,
 (101) ,
 (101) 21

(14),	(11),	(15),	(121),	(13)	
.	.	(15) 1 (154) 1	(151) 2 (151) 2	(152), (152)	(15)
4)	.	가 ,	가 . ,	1 (151) 2 , 2	(15)
152)					
4					
1	2		,	(13)	(13)
, 2			,		
(101)	(13)	(45)	,	(45)	(101)
		.	,	(45)	(13)
			,		
(411),	(412),	(413)	(37)	,	(3)
7)		.	,	(413)	(412)
2	3			가	

(411) (13) . (412) (411) Ta 1nm , Ru, C
u . , Ru , 0.8nm ,

22
 22
 (50) (35), (711), (101)
 , (721), (36) (43)
 . (73) (101)
 . (101) (101),
 . (73) (101) 22
 . 가

(14),	(11),	(15),	(121),	(13)	
.	.	(15) 1 (154) 1	(151) 2 (151) 2	(152), (152)	(15)
4)	.	가 ,	가 . ,	1 (151) 2	(151) 2
152) 4					, 2 (13)
1	(133) 2 , 2	(134)	.	.	(13)
,	22	2	(134)	.	,
,	22	,	(63)	(101)	(13)
.	22	1	(133)	(101)	가
		2	(134)	2	(134)
			가		.
			(13),		.
			(101)		.
			(45)		.

(412), , (413) (45) (413) (13) (412) (411),
2 3
가 .

(411) (13) (412) (411) Ta 1nm , Ru, C
u . (411)
(. (413) (412) (101) (13) (45)
(412) 가 (412) (101) 가 ,
, (412) (13) 가 , (13) (412) (13)
(412) 가 (412) (412) ,
가 .

22 (13) (45)
, ,
(15) ,
22 (121) , (121)
CPP

23 (50)
(10), (45), (40), (35), (36),
(84), (42), (83) , (63) 23
, , , ,
, , , ,
(84), (42), (83)
(63)

24 (91)
(95) (93) , (92) (90) (95) 가 (9)
5) , , , , ,
, , , , ,
(94) (94) , ,
, , , ,
24 (90), (95) (91) (95) 1
, , , ,
(90) (90)

25

가

 $0.2\mu\text{m}$ $0.2\mu\text{m}$

1

가

(57)

1.

가

가

가

가

2.

(感磁)

,
가

,
가 ,
가 ,
가

3.

1 ,

가 가

4.

1 ,

,

5.

1 ,

가

6.

1 ,

Fe, Co, Ni Mn

7.

1 ,

8.

1 ,

9.

1

Ta, Hf, Nb, Ti, W

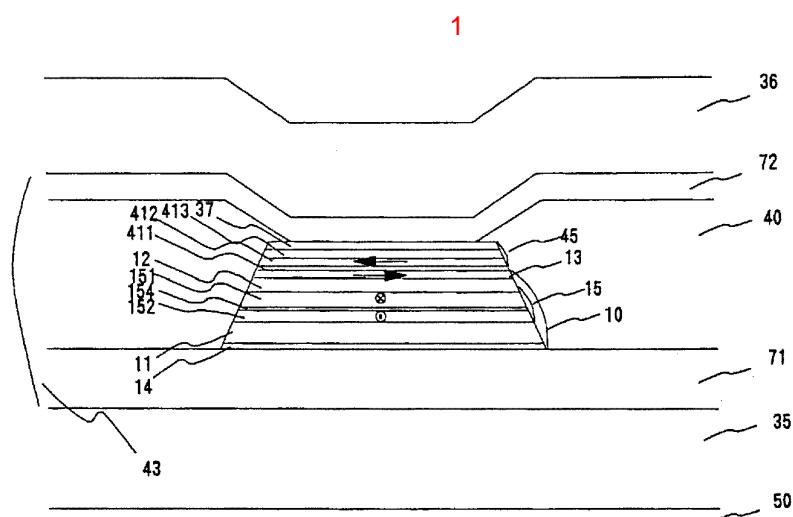
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1

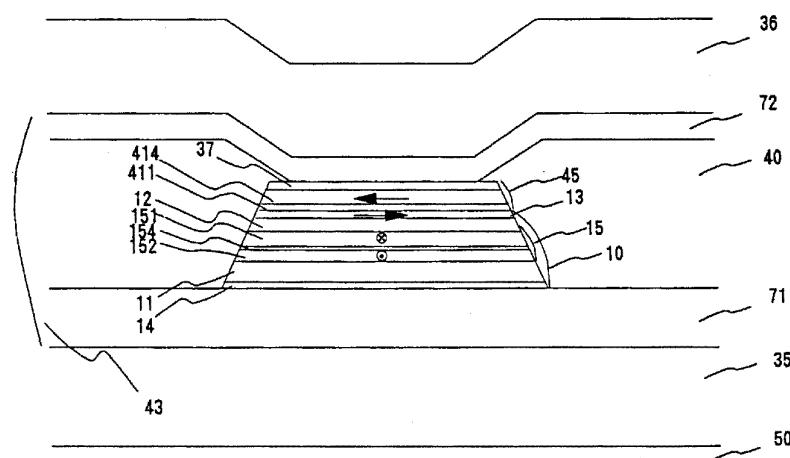
Cu, Au, Ag, Pt, Re, Ru, Ir, Os, Ta, Hf, Nb, Ti, W

, Cu, Au, Ag, Pt, Re, Ru, Ir, Os, Ta, Hf, Nb,

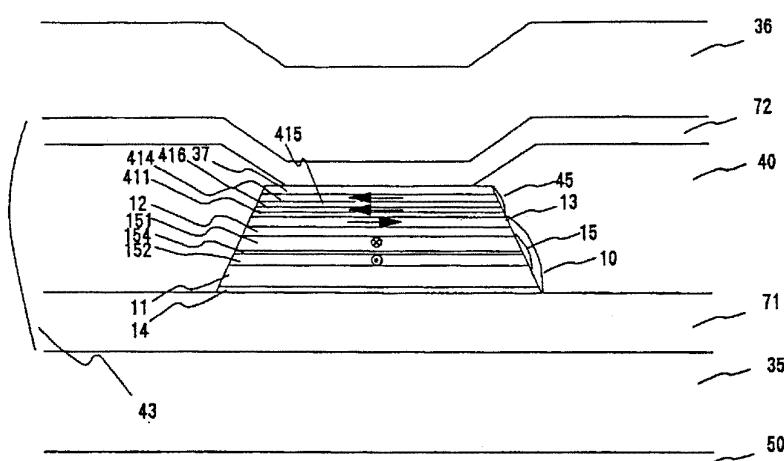
Ti, W



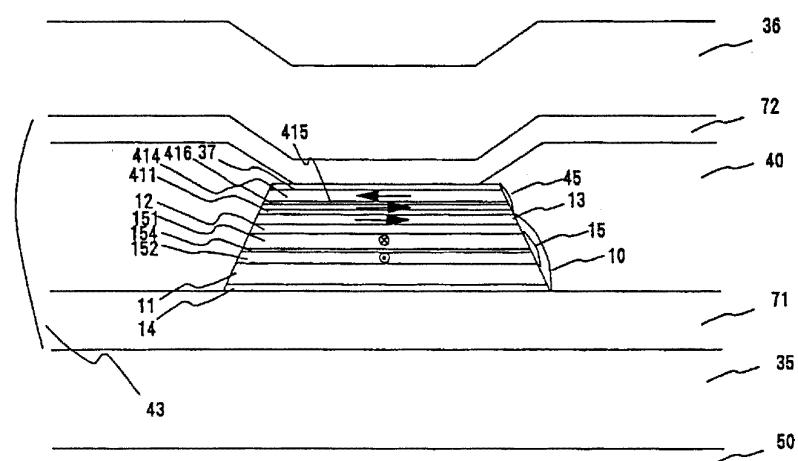
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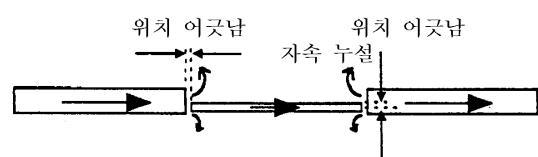
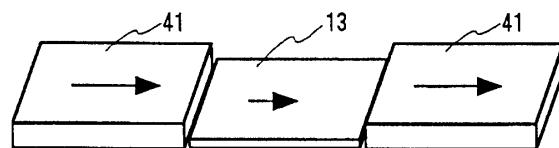
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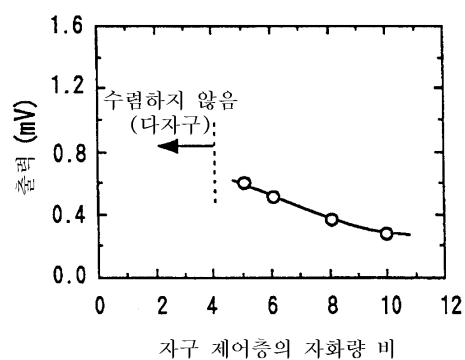
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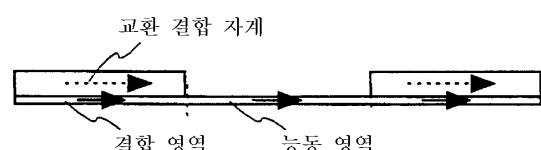
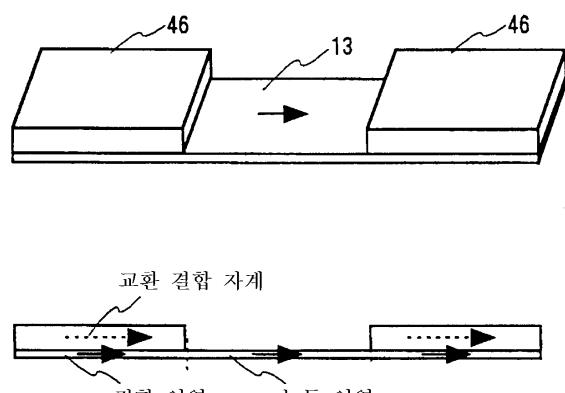
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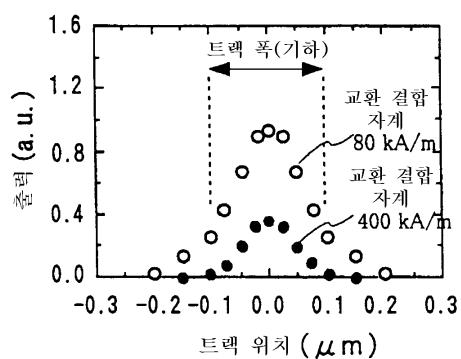
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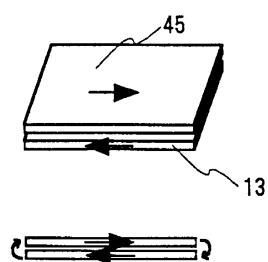
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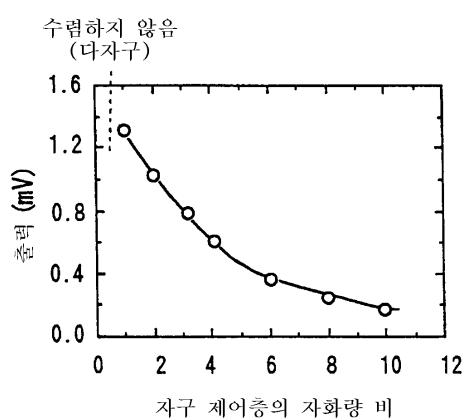
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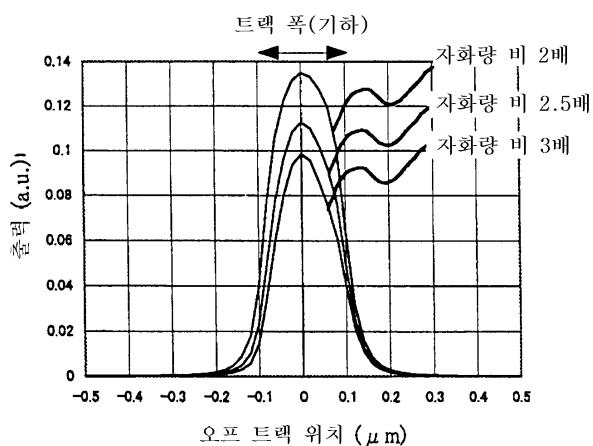
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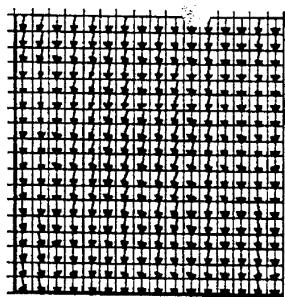


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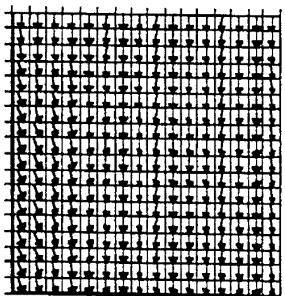


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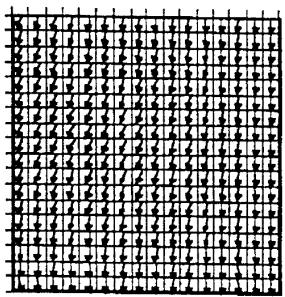




감지해야 할 자계: 쟤로

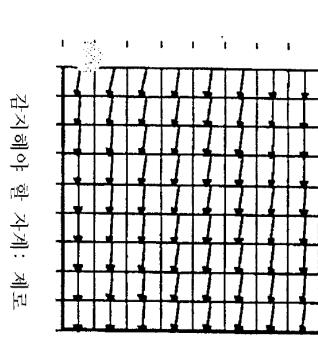


감지해야 할 자계: 콜라스

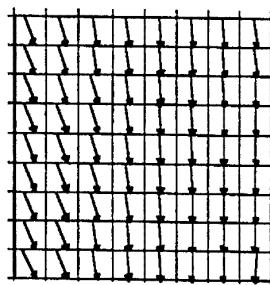


감지해야 할 자계: 마이너스

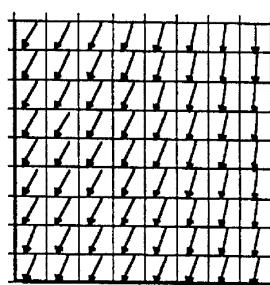
하드 바이어스 맵의 자화 분포



김지혜야 할 차례: 제로

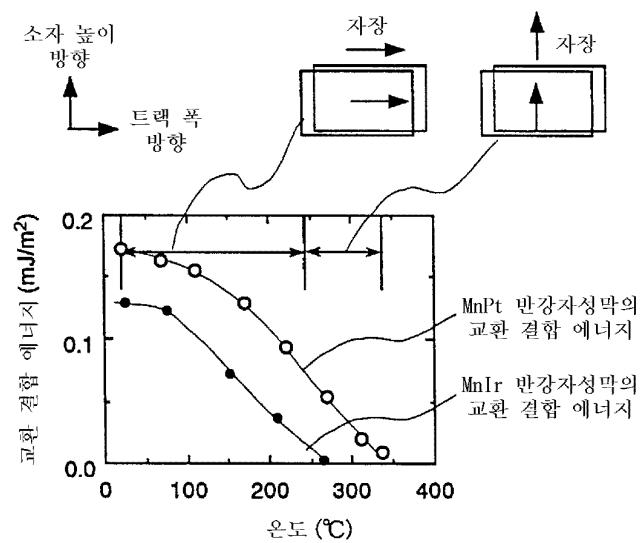


김지혜야 할 차례: 플라스

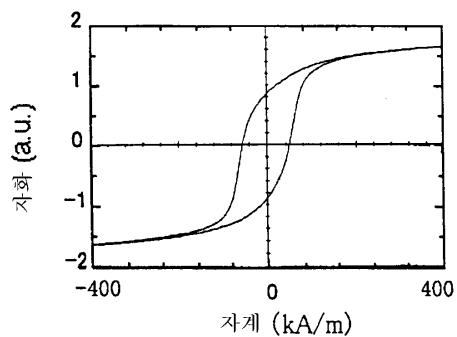


김지혜야 할 차례: 마이너스

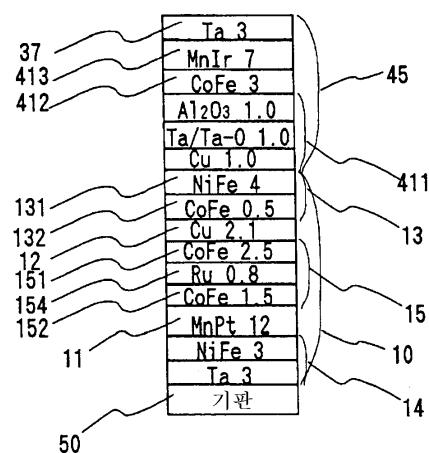
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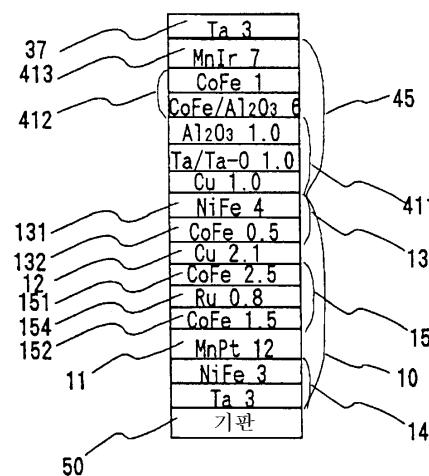
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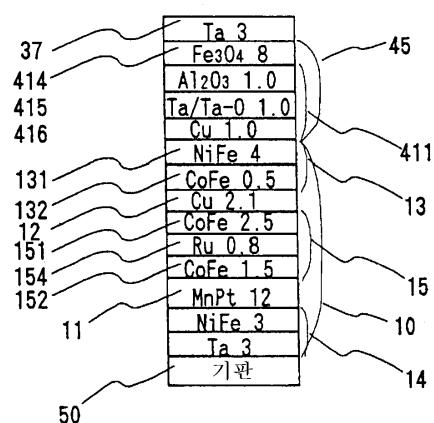
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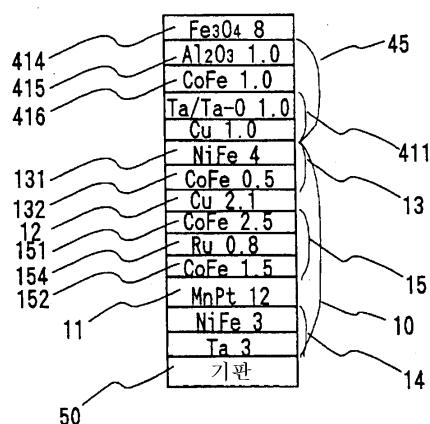
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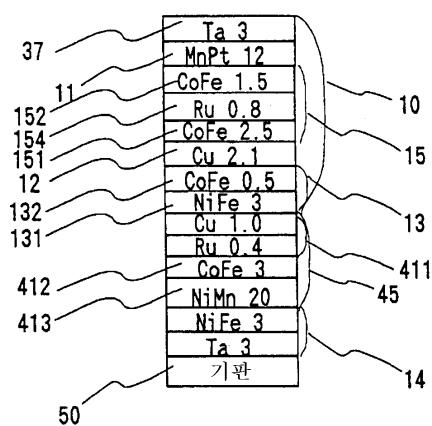
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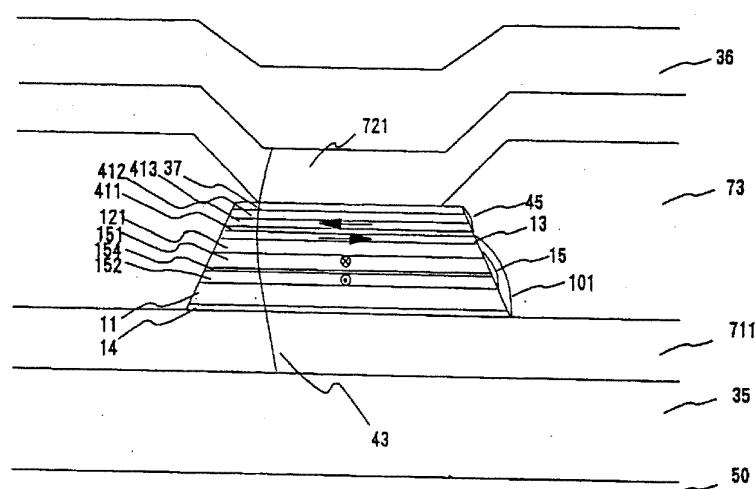
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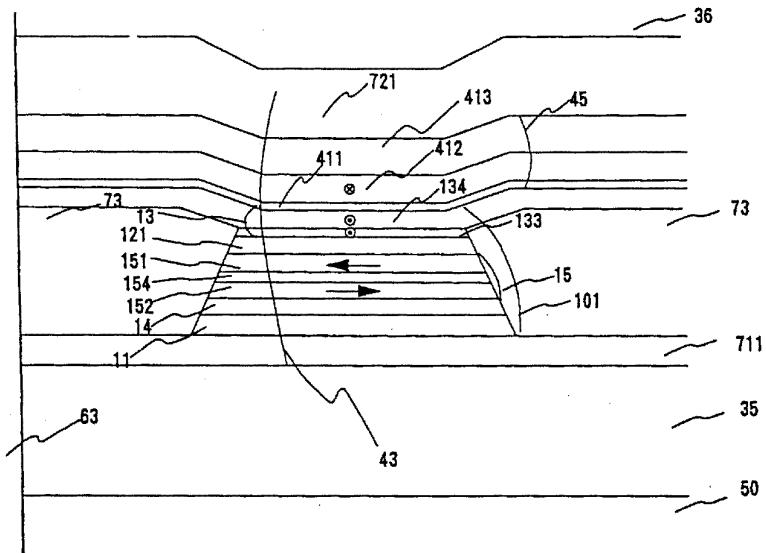
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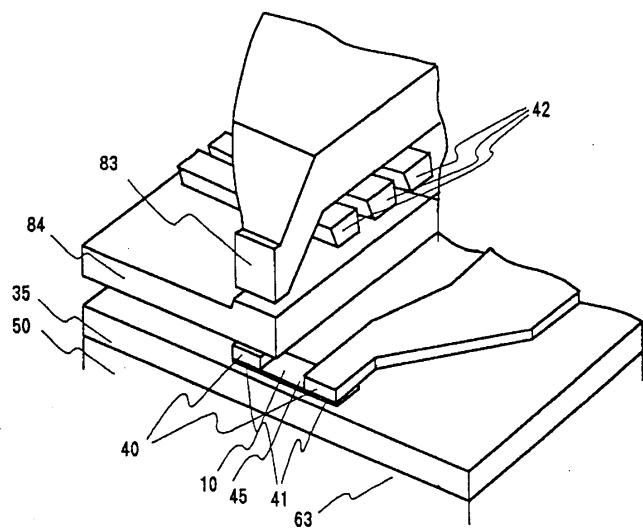
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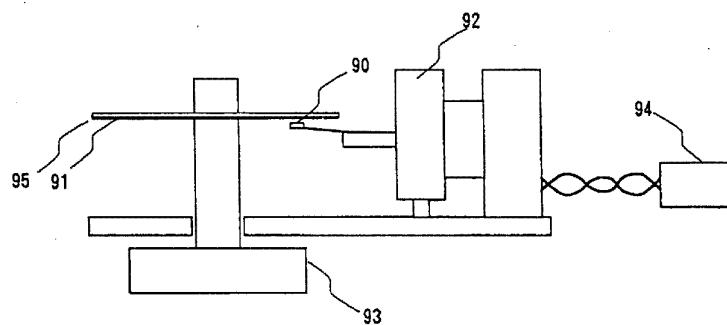
22



23



24



25

