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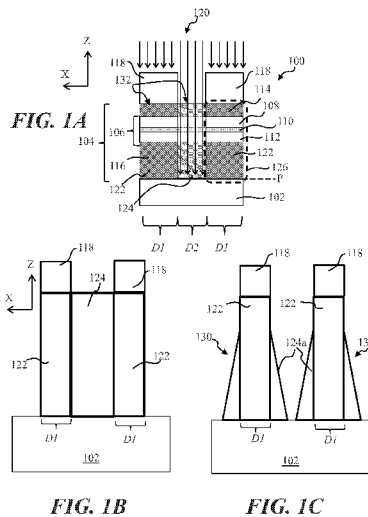
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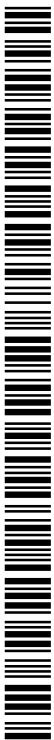
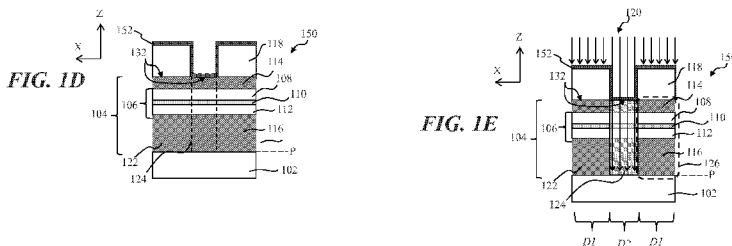
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[Continued on next page]

(54) Title: TECHNIQUES FOR PATTERNING MULTILAYER MAGNETIC MEMORY DEVICES USING ION IMPLANTATION



(57) Abstract: A method of patterning a substrate includes providing a layer stack comprising a plurality of layers on a base portion of the substrate, where the layer stack includes an electrically conductive layer and a magnetic layer. The method further includes forming a first mask feature on an outer surface of the layer stack above a first protected region and a second mask feature on the outer surface of the layer stack above a second protected region, and directing ions towards the layer stack to magnetically isolate and electrically isolate the first protected region from the second protected region.





MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,  
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**INTERNATIONAL SEARCH REPORT**

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**A. CLASSIFICATION OF SUBJECT MATTER**  
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 ADD.  
 According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**  
 Minimum documentation searched (classification system followed by classification symbols)  
 H01L  
 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 936 624 A2 (IBM [US]) 18 August 1999 (1999-08-18) paragraphs [0018], [0022] - paragraph [0026]; figures 1a, 1b -----	1-15
X	WO 2005/013376 A1 (KIMURA MITSUTERU [JP]) 10 February 2005 (2005-02-10) abstract; figure 4 -----	1-15

Further documents are listed in the continuation of Box C.

See patent family annex.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0936624	A2	18-08-1999	
		DE 69923244 D1	24-02-2005
		DE 69923244 T2	12-01-2006
		EP 0936624 A2	18-08-1999
		JP 3368224 B2	20-01-2003
		JP H11288585 A	19-10-1999
		US 6452764 B1	17-09-2002
		US 2001040778 A1	15-11-2001
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WO 2005013376	A1	10-02-2005	
		JP 4287905 B2	01-07-2009
		JP 2005049179 A	24-02-2005
		WO 2005013376 A1	10-02-2005
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