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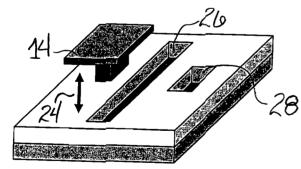
- (71) Applicant (for all designated States except US): MASS-ACHUSETTS INSTITUTE OF TECHNOLOGY [US/US]; 77 Massachusetts Avenue, Cambridge, MA 02139 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): BERGGREN, Karl, K. [US/US]; 30 Harlow Street, #2, Arlington, MA 02474 (US). HARRER, Stefan [DE/DE]; Wendelsteinstrabe 31, 85435 Erding (DE). SALVATORE, Giovanni, A. [IT/IT]; Via Piana 8, I-86020 Spinete (IT). YANG, Joel, K. [MY/US]; 540 Memorial Drive Apt. 1601, Cambridge, MA 02139 (US).

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- (74) Agent: LOBER, Theresa, A.; T. A. Lober Patent Services, 45 Walden Street, Concord, MA 01742 (US).
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impression repetition.

(57) Abstract: In a method for imprinting a layer of material, a nanotemplate is impressed into a material layer, and the nanotemplate is maintained impressed in the material layer until a geometric trench corresponding to geometry of the nanotemplate is formed in the layer, and the nanotemplate is then removed from the material layer. A nanotemplate geometric trench is repeatedly formed in the material layer by nanotemplate impressions in the layer, until a final desired imprint pattern is produced in the layer. Each nanotemplate geometric trench is characterized by an extent that is a fraction of an extent of the final desired imprint pattern. The material layer is maintained in a condition for accepting nanotemplate impressions continuously throughout the nanotemplate



### INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER INV. G03F7/00

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

#### **B. FIELDS SEARCHED**

 $\label{lem:minimum} \mbox{Minimum documentation searched (classification system followed by classification symbols)} \\ \mbox{G03F}$ 

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

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

EPO-Internal, WPI Data, IBM-TDB

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/159019 A1 (LEE KI D [KR]) 21 July 2005 (2005-07-21)	1-26,30, 33-53
1	paragraphs [0035] - [0039]; claims 1,6-9; figures 3-5	27-29, 31,54-60
4		32,61,62
X	US 2005/184436 A1 (JEONG JUN-HO [KR] ET AL) 25 August 2005 (2005-08-25)	1-26,30, 33-53
ſ	NE) 23 Nagast 2003 (2003 00 23)	27-29, 31,54-60
4	paragraphs [0003], [0012], [0016], [0029], [0060], [0062]; claim 11; figures 3,4	32,61,62
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Further documents are listed in the continuation of Box C.	X 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 document 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	<ul> <li>"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</li> <li>"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</li> <li>"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.</li> <li>"&amp;" document member of the same patent family</li> </ul>
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Name and mailing address of the ISA/  European Patent Office, P.B. 5818 Patentlaan 2  NL - 2280 HV Rijswijk  Tel. (+31-70) 340-2040,  Fax: (+31-70) 340-3016	Authorized officer Thiele, Norbert

# **INTERNATIONAL SEARCH REPORT**

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C(Continua	tion). DOCUMENTS CONSIDERED TO BE RELEVANT	
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2005/189676 A1 (SREENIVASAN SIDLGATA V [US]) 1 September 2005 (2005-09-01)  paragraph [0028]; figures 6,7	1-11, 14-27, 30,33-53 12,13, 27-29, 31,54-60 32,61,62
X		
Υ Α .	US 2004/124566 A1 (SREENIVASAN SIDLGATA V [US] ET AL SREENIVASAN SIDLGATA V [US] ET AL) 1 July 2004 (2004-07-01) paragraphs [0008] - [0014], [0141], [0174] - [0179]; claims 1-4	1-11, 14-31, 33-57 12,13, 58-60 32,61,62
X	EP 1 542 074 A (HEPTAGON OY [FI]) 15 June 2005 (2005-06-15)	1-11, 14-27, 30,33-53
Y A	paragraphs [0030] - [0033]; figure 4	12,13, 27-29, 31,54-60 32,61,62
X	MCMACKIN I ET AL: "Design and performance of a step and repeat imprinting machine" PROCEEDINGS OF THE SPIE, SPIE, vol. 5037, 1 January 2003 (2003-01-01), pages 178-186, XP002343365 page 179, lines 9-25	1–11
<b>X</b>	WO 01/20402 A (MASSACHUSETTS INST TECHNOLOGY [US]) 22 March 2001 (2001-03-22) page 12, columns 13-20; claims 1,26,34 page 15, lines 1-21	1-26,29, 55
Α	JP 2002 086463 A (TOPPAN PRINTING CO LTD) 26 March 2002 (2002–03–26) the whole document	1-62
	<del></del>	
		,

## **INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No
PCT/US2006/038949

Patent document cited in search report		Publication date		Patent family member(s)	Publication date	
US 2005159019	A1	21-07-2005	EP JP KR	1594002 A2 2005203797 A 20050075580 A	09-11-2005 28-07-2005 21-07-2005	
US 2005184436	A1	25-08-2005	KR	20050087010 A	31-08-2005	
US 2005189676	A1	01-09-2005	NONE			
US 2004124566	A1	01-07-2004	US	2006076717 A1	13-04-2006	
EP 1542074	Α	15-06-2005	WO US	2005057283 A1 2006259546 A1	23-06-2005 16-11-2006	
WO 0120402	A	22-03-2001	AU EP JP US US	7372800 A 1232419 A1 2003509228 T 2004013982 A1 6517995 B1	17-04-2001 21-08-2002 11-03-2003 22-01-2004 11-02-2003	
JP 2002086463	Α	26-03-2002	NONE			