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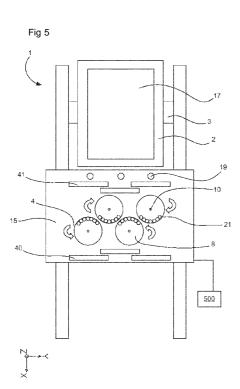
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[Continued on next page]

(54) Title: LITHOGRAPHIC SYSTEM, METHOD OF CONTROLLING A LITHOGRAPHIC APPARATUS AND DEVICE MANUFACTURING METHOD



(57) Abstract: A lithographic system has a lithographic apparatus, an inspection system and a controller. The lithographic apparatus includes a projection system configured to project a radiation beam onto a layer of material on or above a substrate. The inspection system is configured to inspect a pattern formed on the substrate. The pattern is formed on the substrate by application of the radiation beam. The controller is configured to control the lithographic apparatus to form a pattern based on data from an inspection by the inspection system of a previously exposed pattern.



MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

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INTERNATIONAL SEARCH REPORT

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)
This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:
1. Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:
2. Claims Nos.: because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
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Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)
This International Searching Authority found multiple inventions in this international application, as follows:
see additional sheet
1. X As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
Remark on Protest The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
The additional search fees were accompanied by the applicant's protest but the applicable protest '—' fee was not paid within the time limit specified in the invitation.
No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2012/064755 a. classification of subject matter INV. G03F7/20ADD. 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) G03F 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** C. DOCUMENTS CONSIDERED TO BE RELEVANT Category* Citation of document, with indication, where appropriate, of the relevant passages Relevant to claim No. AUYEUNG R C Y ET AL: "Laser forward χ 1-3,9, 14, 15 transfer based on a spati al light modul ator" APPLIED PHYSICS A; MATERIALS SCIENCE & PROCESSING, SPRINGER, BERLIN, DE, vol . 102 , no. 1, 3 October 2010 (2010-10-03), pages 21-26, XP019872341, ISSN: 1432-0630, DOI: 10. 1007/S00339-010-6054-9 abstract secti ons 1 and 2; figures 1,2 ____ -/- ·

X 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 application or patent but published on or after the international filing date
- "L" documentwhich locumentwhich may throw doubts on priority claim(s) orwhich 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
- "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 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 mailing of the international search report

Date of the actual completion of the international search

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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

10/05/2013

Authorized officer

Weckesser, Jens

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/064755

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Polovant to claim No		
ategory	Gration of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
Χ	US 2011/188016 Al (DE JAGER PIETER WILLEM	1,3,6-15		
	HERMAN [NL] ET AL)			
	4 August 2011 (2011-08-04)			
	paragraphs [0078], [0082], [0160],			
	[0171], [0225] - [0228]; figures			
	2,15,16,32			
Χ	US 5 124 927 A (HOPEWELL WILLIAM D [US] ET	1,4-7,		
^	AL) 23 June 1992 (1992-06-23)	14,15		
	abstract	11,13		
	column 6, line 3 - column 8, line 29;			
	figures 2,3,5			
	column 9, line 66 - column 10, line 25			
X	US 2008/052925 Al (HIRASHIMA TAKUYA [JP])	1,3,9,		
	6 March 2008 (2008-03-06)	11-15		
	paragraphs [0039] - [0046], [0055] -			
	[0057]; figure 1			

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/EP2012/064755

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FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-3, 9, 14, 15

Closest pri or art:

Document DI (AUYEUNG R C Y ET AL: "Laser forward transfer based on a spati al light modulator", APPLIED PHYSICS A; MATERIALS SCIENCE & PROCESSING, SPRINGER, BERLIN, DE, vol. 102, no. 1, 3 October 2010 (2010-10-03), pages 21-26, XP019872341, ISSN: 1432-0630, DOI:

10. 1007/S00339-010-6054-9) di scl oses the fol lwi ng features , the references in parentheses applyi ng to thi s document: A li thographi c system

(fi gure 2) compri sing:

a lithographi c apparatus comprising a projecti on system confi gured to project a radi ati on beam onto a layer of materi al on or above a substrate

(lens L2 and microscope objecti ve);

an inspecti on system confi gured to inspect a pattern formed on the substrate, wherein the pattern is formed on the substrate by application of the radiation beam (page 23, left column, last paragraph, optical microscopy); and

a control I er confi gured to control the formati on of a pattern by the I i thographi c apparatus based on data from the inspecti on system rel ati ng to an inspecti on of a previ ously exposed pattern

(impl icit), wherein

the inspecti on system is confi gured to inspect a pattern formed by dropl ets of the material on the substrate (page 23, left col umn, second paragraph), and the lithographic apparatus comprises a programmable patterning device configured to provide a plurality radiation beams

(fi gure 2; digital mi cromi rror devi ce DMD), the projecti on system is confi gured to project the

the projecti on system is confi gured to project the plural ity of radi ati on beams

(page 22, left column, last line - page 23, left column, first paragraph) .

Special techni cal feature, taki ng due account of the descri pti on and drawi ngs:

Specific confi gurati on of the lithographi c apparatus comprising a programmable patterni ng device confi gured to generate a plurality of radiation beams and a projecti on system confi gured to project the plurality of radiation beams onto a layer of material above the substrate so as to cause local deposition of droplets of the material by a laser induced material transfer.

Techni cal effect of this special technical feature: Improved patterning performance of laser induced material transfer by using a plurality of radiation beams. Problem solved by this special technical feature: How to improve the patterning performance of laser induced material transfer.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

2. cl aims: 4-8

Special technical feature, taking due account of the description and drawings:
In-situinspection during patterning using two inspection systems upstream and downstream of the projection system with respect to the scanning movement of the substrate relative to the projection system, which inspect the substrate before and after patterning.

Technical effect of this special technical feature:
Inspect a pattern formed on the substrate almost instantaneously after it has been formed without interference of underlying layers.

Problem solved by this special technical feature:
Fast and accurate feedback control of the lithographic

3. cl aim: 10

apparatus.

Special technical feature, taking due account of the description and drawings:
Lithographic apparatus in the form of a rotor scanner comprising a programmable patterning device.
Technical effect of this special technical feature:
High-throughput pattern transfer.
Problem solved by this special technical feature:
How to increase the throughput of pattern transfer.

4. cl aims: 11-13

Special technical feature, taking due account of the description and drawings:

Alignment system configured to image a fiduciary marker on the substrate/substrate table at varying instants of time as the substrate moves relative to the projection system, and control the pattern formation based on the comparison of the images taken at different instants of time.

Technical effect of this special technical feature:
Form the pattern precisely on the target position of the substrate.

Problem solved by this special technical feature: How to form the pattern precisely on the target position of the substrate, when the substrate is moving relative to the projection system.
