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PCT/US2009/033621(74) Agents: **MORD, Michael, Lewis** et al.; 100 Park Ave., Suite 1500, New York, NY 10017 (US).(22) International Filing Date:
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[Continued on next page]

(54) Title: POLYMER SURFACE FUNCTIONALIZATION AND RELATED APPLICATIONS

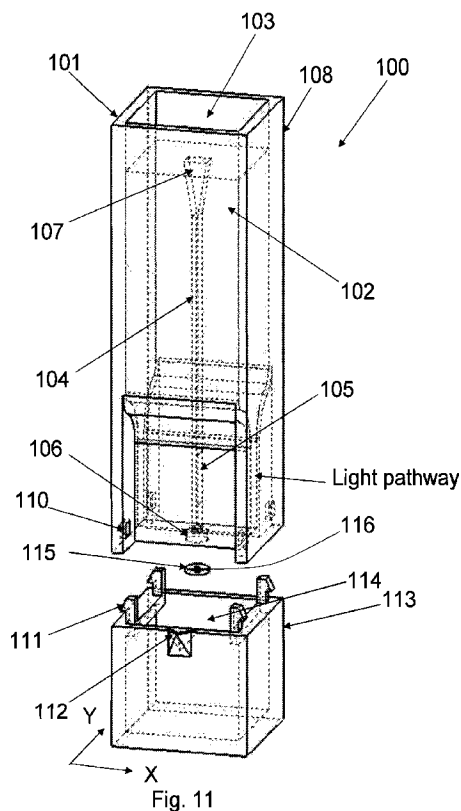


Fig. 11

(57) Abstract: A method to assemble functional materials, such as nanomaterials, onto a polymer surface to create a corresponding functionalized surface involves creating a solution of the functional material, providing a sacrificial substrate, disposing the functional solution onto a surface of the substrate and then covering the substrate with a liquid polymer. The sacrificial substrate is then dissolved, leaving behind a functional surface embedded within the cured polymer. One specific aspect of the invention relates to the embedding of functionalized carbon nanotubes onto a polymer surface for creating a nano-engineered surface. Devices employing functional surfaces are disclosed that are suitable for the immobilization of enzymes, DNA, peptides, proteins, cells, catalyst, and/or other chemicals or molecules for chemical, biochemical, or biological analysis, reactions, filtration.



ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR),
OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML,
MR, NE, SN, TD, TG).

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

(88) Date of publication of the international search report:

30 December 2009

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 09/33621

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B05D 3/10 (2009.01)

USPC - 427/271

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)

USPC:427/271

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 427/269, 271, 273; 428/315.5

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

Pub West: (PGPB,USPT,EPAB,JPAB), Google patent, USPTO

Search terms: functional, material, surface, solution, porous, pipet, dipped, nanowire, nanotube, nanoparticle, water, solvent, soluble, polydimethylsiloxane, PDMS, polypyrrole, epoxy, rubber, plastics, starch, gelatin, lipids, PVA, polyvinyl alcohol, palmitic

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	US 2007/ 0275193 A1 (DeSimone et al.) 29 November 2007 (29.11.2007) para [0063] [0079] [240] [0252] [0255] [268] [278]	1, 5-7, 11-12 ----- 2-4, 8-10
Y	US 6,595,630 B2 (Jagannathan et al.) 22 July 2003 (22.07.2003) (col 4 ln 33-36)	2-4
Y	US 6,597,090 B1 (Mancevski) 22 July 2003 (22.07.2003) (col 1 ln 31-33)	4
Y	US 6,162,838 A (Kohl) 19 December 2000 (19.12.2000) (col 2 ln 62-66, Fig. 1b,1c)	8
Y	US 2002/0155515 A1 (Farina et al.) 24 October 2002 (24.10.2002) para [0042]	9
Y	US 5,919,548 A (Barron et al.) 6 July 1999 (06.07.1999) (col 8 ln 11-26, Fig. 3h)	10

☐ Further documents are listed in the continuation of Box C.

* 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

21 May 2009 (21.05.2009)

Date of mailing of the international search report

01 JUN 2009

Name and mailing address of the ISA/US

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 09/33621

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:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

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:

Group 1: claims 1-12

Group 2: claims 13-22

Group 3 : claims 23-27

--see extra sheet for details ---

1. ☐ 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 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.:
4. ☒ 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.:
1-12

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/US 09/33621

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1.

Group I: claims 1-12, drawn to a method for making a functionalized surface, comprising: contacting a functional solution with a sacrificial material; disposing a liquid polymer onto the sacrificial material; allowing the liquid polymer to cure; and dissolving the sacrificial material from the cured polymer.

Group II: claims 13-22, drawn to a fluidic device comprising: an enclosure body; an inlet in the enclosure body; an outlet in the enclosure body; a fluidic channel in the enclosure body fluidly connecting the inlet to the outlet; and a functional surface in the fluidic channel.

Group III: claims 23-27, drawn to a microtiter device comprising: a body; and a plurality of spots disposed in the body, each of the plurality of spots comprising a functional surface.

The inventions listed as Groups I-III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Groups II and III do not include the inventive concept of method for making a functionalized surface, comprising: contacting a functional solution with a sacrificial material; disposing a liquid polymer onto the sacrificial material; allowing the liquid polymer to cure; and dissolving the sacrificial material from the cured polymer, as required by Group I.

Groups I and III do not include the inventive concept of a fluidic device comprising: an enclosure body; an inlet in the enclosure body; an outlet in the enclosure body; a fluidic channel in the enclosure body fluidly connecting the inlet to the outlet; and a functional surface in the fluidic channel, as required by Group II.

Groups I and II do not include the inventive concept of microtiter device comprising: a body; and a plurality of spots disposed in the body, each of the plurality of spots comprising a functional surface, as required by Group III.

None of these technical features are shared by the other groups, nor do they correspond to a special technical feature in the other groups. Therefore, unity of invention is lacking.