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

[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR IDENTIFYING AND CHARACTERIZING MATERIAL SOLVENTS AND COMPOSITE MATRICES AND METHODS OF USING SAME

CONDUCTIVITY OF SOLVENT CAST nm THICK GRAPHENE FILMS ON
Si WAFER NORMALIZED TO ITO CONDUCTIVITY

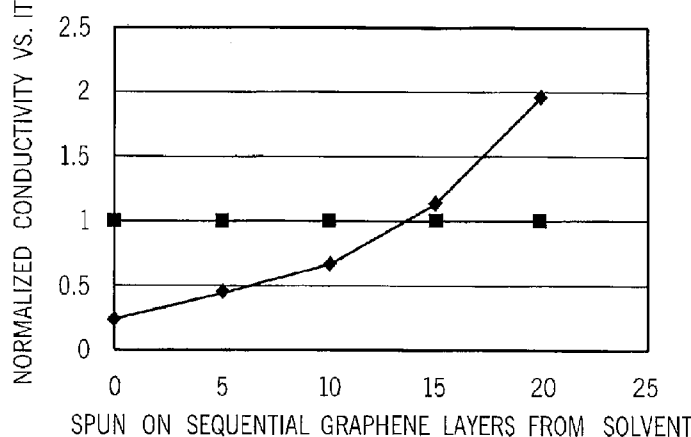


FIG. 27

—■— GRAPHENE
—◆— ITO~10um

(57) Abstract: Solvents for macro-molecules generally believed to be insoluble in their pristine form are identified by generation of a 'solvent resonance' in the relationship between solvent quality (deduced by Rayleigh scattering) and an intrinsic property of solvents. A local extreme of the solvent resonance identifies the ideal intrinsic property of an ideal solvent which may then be used to select a particular solvent or solvent combination. A solvent for graphene is used in the production of transparent conductive electrodes.



— *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

International application No
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A. CLASSIFICATION OF SUBJECT MATTER

INV. C03C17/22 C09D1/00 C09D5/24 H01B1/04 C01B31/02
G01N21/49

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)

C03C C09D H01B C01B G01N

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, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	X. WANG ET AL: "Transparent, conductive graphene electrodes for dye-sensitized solar cells" NANO LETTERS, vol. 8, no. 1, 12 November 2007 (2007-11-12), pages 323-327, XP002521165	1,2,4,8
Y	the whole document ----- -/--	1-19,21

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

☒ 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

- *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

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2009/030306

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GIORDANI S ET AL: "Debundling of single-walled nanotubes by dilution: observation of large populations individual nanotubes in amide solvent dispersions" JOURNAL OF PHYSICAL CHEMISTRY B ACS USA, vol. 110, no. 32, 17 August 2006 (2006-08-17), pages 15708-15718, XP002521164 ISSN: 1089-5647 page 15716, left-hand column, line 7 - line 9 page 15717, left-hand column, line 6 - line 27	1-19,21
Y	----- US 2007/284557 A1 (GRUNER GEORGE [US] ET AL) 13 December 2007 (2007-12-13) paragraphs [0006], [0019] - [0023], [0026]	1-19,21
X,P	----- Y. HERNANDEZ ET AL: "High-yield production of graphene by liquid-phase exfoliation of graphite" NATURE NANOTECHNOLOGY, vol. 3, 10 August 2008 (2008-08-10), pages 563-568, XP002521166 "Abstract", first paragraph of "Dispersion of graphite"	1-19,21
A	----- UMEK P ET AL: "An effective surfactant-free isolation procedure for single-wall carbon nanotubes" CARBON, ELSEVIER, OXFORD, GB, vol. 40, no. 14, 1 January 2002 (2002-01-01), pages 2581-2585, XP004385696 ISSN: 0008-6223 "Abstract"	1-19,21

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/030306

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:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable 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 reportcovers 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.:

1-19, 21

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-19,21

Method for manufacturing a conductive material comprising graphene sheets by treating them with a solvent characterized by a value of χ less than 0.01. Graphene treated by such a solvent and conductive material thereof.

2. claim: 20

Method for characterizing solvent/solute systems

3. claim: 22

Solvent for use in forming a solution of carbon nanotubes.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2009/030306

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007284557 A1	13-12-2007	US 2009017211 A1	15-01-2009