

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
6 August 2009 (06.08.2009)

PCT

(10) International Publication Number  
**WO 2009/097184 A3**

(51) International Patent Classification:

*C08K 7/22* (2006.01)      *B82B 1/00* (2006.01)  
*C08K 7/24* (2006.01)      *C08K 3/00* (2006.01)  
*C08K 3/04* (2006.01)      *C08K 5/37* (2006.01)  
*C08K 3/10* (2006.01)      *C08L 33/04* (2006.01)  
*C08J 9/22* (2006.01)

(21) International Application Number:

PCT/US2009/030860

(22) International Filing Date:

13 January 2009 (13.01.2009)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/011,030      14 January 2008 (14.01.2008)      US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, 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).

Published:

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

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

18 March 2010

(54) Title: ORDERED POROUS MESOSTRUCTURED MATERIALS FROM NANOPARTICLE-BLOCK COPOLYMER SELF-ASSEMBLY

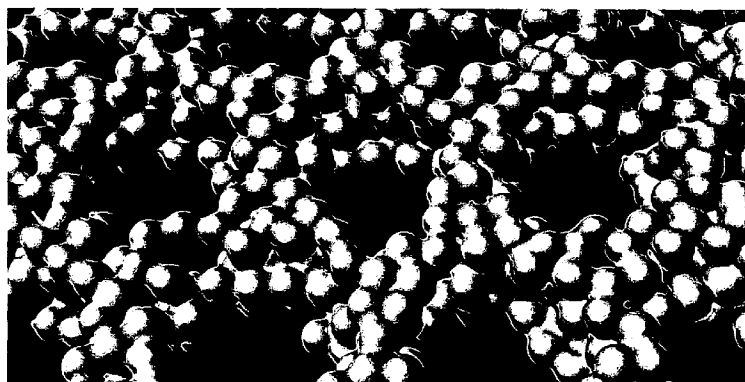


FIG. 1F

(57) Abstract: The invention provides mesostructured materials and methods of preparing mesostructured materials including metal-rich mesostructured nanoparticle-block copolymer hybrids, porous metal-nonmetal nanocomposite mesostructures, and ordered metal mesostructures with uniform pores. The nanoparticles can be metal, metal alloy, metal mixture, intermetallic, metal-carbon, metal-ceramic, semiconductor-carbon, semiconductor-ceramic, insulator-carbon or insulator-ceramic nanoparticles, or combinations thereof. A block copolymer/ligand-stabilized nanoparticle solution is cast, resulting in the formation of a metal-rich (or semiconductor-rich or insulator-rich) mesostructured nanoparticle-block copolymer hybrid. The hybrid is heated to an elevated temperature, resulting in the formation of an ordered porous nanocomposite mesostructure. A nonmetal component (e.g., carbon or ceramic) is then removed to produce an ordered mesostructure with ordered and large uniform pores.



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**A. CLASSIFICATION OF SUBJECT MATTER**

*C08K 7/22(2006.01)i, C08K 7/24(2006.01)i, C08K 3/04(2006.01)i, C08K 3/10(2006.01)i, C08J 9/22(2006.01)i, B82B 1/00(2006.01)i, C08K 3/00(2006.01)i, C08K 5/37(2006.01)i, C08L 33/04(2006.01)i*

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)

IPC : C08K 7/22, C08K 7/24, C08K 3/04, C08K 3/10, C08J 9/22, B82B 1/00, C08K 3/00, C08K 5/37, C08L 33/04

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)

eKOMPASS(KIPO internal), PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 2006/0057464 A1 (Kwang Man Kim et al.) 16 Mar. 2006 See the abstract, the figures; and the claims.	60-63, 67, 68 1-24, 27-38, 40-48, 69, 70
X A	JP 14-190324 A (KOREA ELECTRONICS TELECOMMUN) 05 July 2002 See the abstract; examples 1-6; and the claims.	60-63, 67, 68 1-24, 27-38, 40-48, 69, 70
X A	JP 19-308544 A (HITACHI LTD) 29 Nov. 2007 See the abstract; and the claims.	25,26,39,60,61,64-66 1-24, 27-38, 40-48, 69, 70
X A	JP 15-342411 A (ASAHI GLASS CO LTD.) 03 Dec. 2003 See the abstract; and the claims.	25,26,39,60,61,64-66 1-24, 27-38, 40-48, 69, 70
X A	A. Quaranta et al., "Optical sensing to organic vapors of fluorinated polyimide nanocomposites containing silver nanoclusters", Sensors and Actuators B, 2006, 118, pages 418-424 See the abstract.	60-63 1-24, 27-38, 40-48, 69, 70

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 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 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

24 NOVEMBER 2009 (24.11.2009)

Date of mailing of the international search report

**30 NOVEMBER 2009 (30.11.2009)**

Name and mailing address of the ISA/KR



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**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 I, claims 1-48, 60-70 is directed to a method for preparing a porous metal-carbon nanocomposite mesostructure which comprises steps (a) to (c) , and a product or composition prepared from the method.

Group II, claims 49-59, is directed to a ligand suitable for stabilizing nanoparticles which comprises specific ether part and ammonium part, and thiol, amine, phosphine or selenide part.

Since the above mentioned groups of claims do not share any of the technical features identified, a "technical relationship" between the inventions, as defined in PCT Rule 13.2 does not exist. Accordingly the international application does not relate to one invention or to a single inventive concept. (PCT Rule 13.1 and 13.2)

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 an additional fee, this Authority did not invite payment of any additional fee.
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.: 1-48,60-70

**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/US2009/030860**

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-0764613 B1 (SEOUL NATIONAL UNIVERSITY INDUSTRY FOUNDATION) 08 Oct. 2007 See the abstract; and the claims.	1-48, 60-70
A	Lilei Ye et al., "Effect of Ag Particle Size on Electrical Conductivity of Isotropically Conductive Adhesives", IEEE TRANSACTIONS ON ELECTRONICS PACKAGING MANUFACTURING, 1999, Vol. 22, No. 4, pages 299 to 302. See the abstract.	1-48, 60-70
A	Stephan Hermes et al., "Loading of porous metal-organic open frameworks with organometallic CVD precursors: inclusion compounds of the type [LnM]a@MOF-5", J. Mater. Chem., 2006, 16, pages 2464 to 2472 See the abstract.	1-48, 60-70

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2009/030860**

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JP 15-342411 A	03.12.2003	AU 2003-241913 A1 AU 2003-241913 A1 WO 2003-099915 A1	12.12.2003 29.05.2003 04.12.2003
KR 10-0764613 B1	08.10.2007	None	