



- (51) International Patent Classification:  
C09K 11/88 (2006.01)
- (21) International Application Number:  
PCT/IB2014/059938
- (22) International Filing Date:  
18 March 2014 (18.03.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
1163/CHE/2013 18 March 2013 (18.03.2013) IN
- (71) Applicant: JAWAHARLAL NEHRU CENTRE FOR  
ADVANCED SCIENTIFIC RESEARCH [IN/IN];  
Jakkur, Bangalore, Karnataka, 560 064 (IN).
- (72) Inventors: VISWANATHA, Ranjani; International  
Centre for Materials Science and New Chemistry Unit,  
Jawaharlal Nehru Centre for Advanced Scientific Research,  
Jakkur P.O., Jakkur, Bangalore, Karnataka 560 064 (IN).  
SAHA, Avijit; New Chemistry Unit, Jawaharlal Nehru  
Centre for Advanced Scientific Research, Jakkur P.O.,  
Jakkur, Bangalore, Karnataka 560 064 (IN). NARAYAN,  
Kavassery Sureswaran; Chemistry and Physics of Materials  
Unit, Jawaharlal Nehru Centre for Advanced Scientific  
Research, Jakkur P.O., Jakkur, Bangalore, Karnataka 560  
064 (IN). CHELLAPPAN, Kishore Velichappattu;  
Chemistry and Physics of Materials Unit, Jawaharlal Nehru  
Centre for Advanced Scientific Research, Jakkur P.O.,  
Jakkur, Bangalore, Karnataka 560 064 (IN).
- (74) Agents: RAVINDRANATH, Meenakshi et al.; K & S  
Partners, Intellectual Property Attorneys, 4121/B, 6th  
Cross, 19A Main, HAL II Stage (Extension), Bangalore,  
Karnataka 560 038 (IN).

(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, BN, BR, BW, BY,  
BZ, CA, CH, CL, 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, IR, IS, JP, KE, KG, 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, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,  
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, 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, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,  
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,  
TM), European (AL, 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, RS, SE, SI, SK, SM,  
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,  
KM, ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17:**

- as to the applicant's entitlement to claim the priority of the  
earlier application (Rule 4.17(iii))
- of inventorship (Rule 4.17(iv))

**Published:**

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

(88) Date of publication of the international search report:  
2 April 2015

(54) Title: CD-BASED-CHALCOGENIDE/CDS CORE-SHELL NANOMATERIAL, DEFECTIVE/DEFECT-FREE CORE  
NANOCRYSTAL, METHODS AND APPLICATIONS THEREOF

(57) Abstract: The present disclosure relates to semiconductor nanomaterials, preferably quantum dots (QDs), methods to obtain  
said nanomaterials and applications thereof. More particularly, the present disclosure relates to Cd-based-chalcogenide/CdS core-  
shell nanomaterial starting from a defective core nanocrystal and thick shell structure (greater than 3 nm thickness) with a high  
quantum yield (greater than 80%), and methods of obtaining the said nanomaterial. The present disclosure further relates to defect-  
ive/defect-free Cd-based-chalcogenide core nanocrystal and method for synthesizing the defective/defect-free core. The present dis-  
closure also relates to devices and applications of said nanomaterial and the defective/defect-free Cd-based-chalcogenide core.



**INTERNATIONAL SEARCH REPORT**

International application No.  
PCT/IB2014/059938

<p><b>A. CLASSIFICATION OF SUBJECT MATTER</b>                  IPC(8) - C09K 11/88 (2014.01)                  CPC - C09K 11/88 (2014.10)                  According to International Patent Classification (IPC) or to both national classification and IPC</p>																							
<p><b>B. FIELDS SEARCHED</b></p> <p>Minimum documentation searched (classification system followed by classification symbols)                  IPC(8) - C09K 11/54, 11/88 (2014.01)                  CPC - C09K 11/54, 11/565, 11/88, 11/881, 11/883 (2014.10) (keyword delimited)</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched                  USPC - 252/301.4S, 252/519.34, 252/519.4 (keyword delimited)</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)                  Orbit, Google Patents, Google Scholar                  Search terms used: cds core shell nanomaterials defect</p>																							
<p><b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b></p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X ---</td> <td>US 2003/0066998 A1 (LEE) 10 April 2003 (10.04.2003) entire document</td> <td>1-5, 15, 16, 22-24 -----</td> </tr> <tr> <td>Y</td> <td></td> <td>8-11, 17-19</td> </tr> <tr> <td>X ---</td> <td>US 2012/0049119 A1 (GREYTAK et al) 01 March 2012 (01.03.2012) entire document</td> <td>6 -----</td> </tr> <tr> <td>Y</td> <td></td> <td>7-11</td> </tr> <tr> <td>Y</td> <td>US 2008/0237546 A1 (LOCASIO et al) 02 October 2008 (02.10.2008) entire document</td> <td>7</td> </tr> <tr> <td>Y</td> <td>US 2011/0233468 A1 (ZONG et al) 29 September 2011 (29.09.2011) entire document</td> <td>10, 11, 17-19</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X ---	US 2003/0066998 A1 (LEE) 10 April 2003 (10.04.2003) entire document	1-5, 15, 16, 22-24 -----	Y		8-11, 17-19	X ---	US 2012/0049119 A1 (GREYTAK et al) 01 March 2012 (01.03.2012) entire document	6 -----	Y		7-11	Y	US 2008/0237546 A1 (LOCASIO et al) 02 October 2008 (02.10.2008) entire document	7	Y	US 2011/0233468 A1 (ZONG et al) 29 September 2011 (29.09.2011) entire document	10, 11, 17-19
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<p><input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/></p>																							
<p>* Special categories of cited documents:</p> <table border="0"> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"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</td> </tr> <tr> <td>"E" earlier application or patent but published on or after the international filing date</td> <td>"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</td> </tr> <tr> <td>"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)</td> <td>"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</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td>"&amp;" document member of the same patent family</td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance	"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	"E" earlier application or patent but published on or after the international filing date	"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	"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)	"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	"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family	"P" document published prior to the international filing date but later than the priority date claimed												
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"P" document published prior to the international filing date but later than the priority date claimed																							
<p>Date of the actual completion of the international search 11 December 2014</p>		<p>Date of mailing of the international search report <b>19 DEC 2014</b></p>																					
<p>Name and mailing address of the ISA/US                  Mail Stop PCT, Attn: ISA/US, Commissioner for Patents                  P.O. Box 1450, Alexandria, Virginia 22313-1450                  Facsimile No. 571-273-3201</p>		<p>Authorized officer:                  Blaine R. Copenheaver                  PCT Helpdesk: 571-272-4300                  PCT OSP: 571-272-7774</p>																					

INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IB2014/059938

**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.: 12-14, 20, 21  
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:

- 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.:

- 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.