

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



PCT



(43) International Publication Date  
7 February 2008 (07.02.2008)

(10) International Publication Number  
**WO 2008/016375 A3**

(51) **International Patent Classification:**  
**GOIN 21/65 (2006.01)**

(21) **International Application Number:**  
**PCT/US2006/048009**

(22) **International Filing Date:**  
14 December 2006 (14.12.2006)

(25) **Filing Language:** English

(26) **Publication Language:** English

(30) **Priority Data:**  
11/319,747 29 December 2005 (29.12.2005) US

(71) **Applicant (for all designated States except US): INTEL CORPORATION** [US/US]; 2200 Mission College Boulevard, Santa Clara, CA 95052 (US).

(72) **Inventors; and**

(75) **Inventors/Applicants (for US only): ZHANG, Jingwu** [US/US]; 950 Foxworthy Avenue, San Jose, CA 95125 (US). **SUNDARARAJAN, Narayan** [IN/US]; 126 Crsepi Drive, San Francisco, CA 94132 (US). **NGOLA, Sarah, M.** [US/US]; 1244 Balboa Court, Apt. 13, Sunnyvale, CA 94086 (US). **LI, Handong** [CN/US]; 1352 Petal Way, San Jose, CA 95129 (US).

(74) **Agent: DARBY & DARBY P.C.;** P.O. Box 770, Church Street Station, New York, New York 10008-0770 (US).

(81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, **BR**, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, 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, LV, 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, 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, HU, IE, IS, IT, LT, LU, LV, MC, NL, 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
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) **Date of publication of the international search report:**  
14 August 2008

(54) **Title:** MODIFICATION OF METAL NANOPARTICLES FOR IMPROVED ANALYTE DETECTION BY SURFACE ENHANCED RAMAN SPECTROSCOPY (SERS)

(57) **Abstract:** A SERS active particle having a metal-containing particle and a cationic coating on the metal-containing particle, wherein the SERS active particle carries a positive charge is disclosed. Also, a SERS active particle having a metal-containing particle and a non-metallic molecule, wherein the metal-containing particle is derivatized with the non-metallic molecule is disclosed. In addition, several methods of modifying the nanoparticles surfaces of a SERS active particle and of improving the interaction between the SERS active particle and an analyte are disclosed.



**WO 2008/016375 A3**

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2006/048009

## A. CLASSIFICATION OF SUBJECT MATTER

INV. G01N21/65

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)  
GOIN

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, WPI Data, EMBASE<sub>3</sub> BIOSIS, MEDLINE, FSTA, INSPEC, COMPENDEX

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                                                                                                                                                        | Relevant to claim No.           |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| X         | MARUYAMA Y ET AL: "Elastic scattering and emission correlated with single-molecule SERS"<br>JOURNAL OF RAMAN SPECTROSCOPY WILEY UK,<br>vol. 36, no. 6-7, June 2005 (2005-06),<br>pages 581-592, XP002469519<br>ISSN: 0377-0486<br>abstract<br>page 581, right-hand column, paragraph 1 -<br>page 582, left-hand column<br>page 582, right-hand column, last<br>paragraph<br>-----<br>-/-- | 1-5, 16,<br>21-23,<br>26, 71-76 |

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

☐ See patent family annex.

\* Special categories of cited documents :

<sup>1</sup>A- document defining the general state of the art which is not considered to be of particular relevance

<sup>1</sup>E- earlier document but published on or after the international filing date

<sup>1</sup>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)

<sup>1</sup>O- document referring to an oral disclosure, use, exhibition or other means

<sup>1</sup>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

11 March 2008

Date of mailing of the International search report

01/07/2008

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Michal itsch, Richard

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2006/048009

| C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                                                                                                                                                                                                                                                                                                                                   |                                             |
|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|
| Category*                                            | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                                                                                                                                                                                | Relevant to claim No.                       |
| X                                                    | <p>KANG WANG ET AL: "Surfactant-aided surface-enhanced resonance Raman spectroscopic study of some anionic dye molecules"</p> <p>JOURNAL OF RAMAN SPECTROSCOPY WILEY UK, vol . 27, no. 5, May 1996 (1996-05), pages 385-389, XP002469520</p> <p>ISSN: 0377-0486</p> <p>pages 386-387</p> <p>page 389, left-hand column</p> <p style="text-align: center;">-----</p>                                               | <p>1-5, 16, 17, 21-23, 26, 46-49, 71-77</p> |
| X                                                    | <p>KUO PING-LIN ET AL: "Formation of silver nanoparticles under structured amino groups in pseudo-dendritic poly(allylamine) derivatives"</p> <p>J PHYS CHEM B; JOURNAL OF PHYSICAL CHEMISTRY B OCT 16 2003, vol . 107, no. 41, 16 October 2003 (2003-10-16) , pages 11267-11272, XP002469521</p> <p>page 11267; figure 1</p> <p style="text-align: center;">-----</p>                                            | <p>1-5, 16, 21-23, 26, 71-74</p>            |
| P <sub>5</sub> X                                     | <p>KIM KWAN ET AL: "Silver-particle-based surface-enhanced Raman scattering spectroscopy for biomolecular sensing and recognition."</p> <p>LANGMUIR : THE ACS JOURNAL OF SURFACES AND COLLOIDS 28 MAR 2006, vol . 22, no. 7, 28 March 2006 (2006-03-28) , pages 3421-3427, XP002469522</p> <p>ISSN: 0743-7463</p> <p>abstract</p> <p>page 3421 - page 3422; figure 1</p> <p style="text-align: center;">-----</p> | <p>1-5, 16, 17, 21-23, 26, 46-49, 71-77</p> |
| X                                                    | <p>WEI GANG ET AL: "DNA-network-templated self-assembly of silver nanoparticles and their application in surface-enhanced Raman scattering"</p> <p>J PHYS CHEM B; JOURNAL OF PHYSICAL CHEMISTRY B DEC 22 2005, vol . 109, no. 50, 22 December 2005 (2005-12-22) , pages 23941-23947, XP002469523</p> <p>page 23941 - page 23943</p> <p style="text-align: center;">-----</p>                                      | <p>1-5, 21-23</p>                           |

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2006/048009

## 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. **D** 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 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.:

siehe Beibl att

### 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: 1-5 (in part), 16-23 (in part), 26,27, 28-30 (in part)  
46-50 (in part), 71-77 (in part)

Particles with a cationic coating based on ions, method of preparation and method of contacting an analyte by electrostatic interaction between the analyte and the sers particle.

---

2. claims: 1-5 (in part) 6,16-23 (in part), 28-30 (in part) 46-50  
(in part) 71-77 (in part)

Particles with a cationic coating based on thiol compounds, method of preparation and method of contacting an analyte therewith.

---

3. claims: 1-5 (in part), 8,9 (in part), 10, 16-23 (in part), 24,  
28-30 (in part), 46-50 (in part), 71-77  
(in part), 79,81

Particles-with a cationic coating based on polymers, method of preparation, and method of contacting an analyte therewith.

---

4. claims: 1-5 (in part), 7, 9, 16-23 (in part), 25, 28-30 (in  
part), 46-50 (in part), 71-77 (in part),  
78, 80

SERS Particles with a cationic coating based on nanoparticles, method of preparation and method of contacting an analyte therewith.

---

5. claims: 11-15 (in part), 31-40, 51-56, 82-86 (in part)

SERS particles with an attached non-metallic (neutral) hydrophobic molecule, method of production, and method of contacting an analyte by hydrophobic interaction between the analyte and the coated SERS particle.

---

6. claims: 11-15 (in part), 41-45, 57-70, 82-86 (in part), 87-91

SERS particles with an attached non-metallic (neutral) molecule having a specific binding site, method of production, and method of contacting an analyte therewith.

---