

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
5 May 2011 (05.05.2011)

(10) International Publication Number
WO 2011/053901 A3

(51) International Patent Classification:

G01N 33/53 (2006.01) *G01N 27/72* (2006.01)
G01N 33/574 (2006.01) *A61K 49/16* (2006.01)

(21) International Application Number:

PCT/US2010/054939

(22) International Filing Date:

1 November 2010 (01.11.2010)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/256,603 30 October 2009 (30.10.2009) US

(71) Applicant (for all designated States except US):
NORTHWESTERN UNIVERSITY [US/US]; 633
Clark Street, Evanston, Illinois 60208 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **DRAVID, Vinayak P.** [US/US]; 980 Queensland, Glenview, Illinois 60025 (US). **SHARMA, Saurabh** [IN/US]; 2336 W. Nichols Road, Apt. #B, Arlington Heights, Illinois 60004 (US). **TOMITA, Tadanori** [US/US]; 1410 Burr Oak, Glenview, Illinois 60025 (US). **VIOLA, Kirsten L.** [US/US]; 1416 Fairway Drive, Lake Forest, Illinois 60045 (US).

KLEIN, William L. [US/US]; 1145 Chatfield Dr., Winnetka, Illinois 60093 (US).

(74) Agent: **ARENSEN, Tanya A.**; Casimir Jones, S.C., 2275 Deming Way, Suite 310, Middleton, Wisconsin 53562 (US).

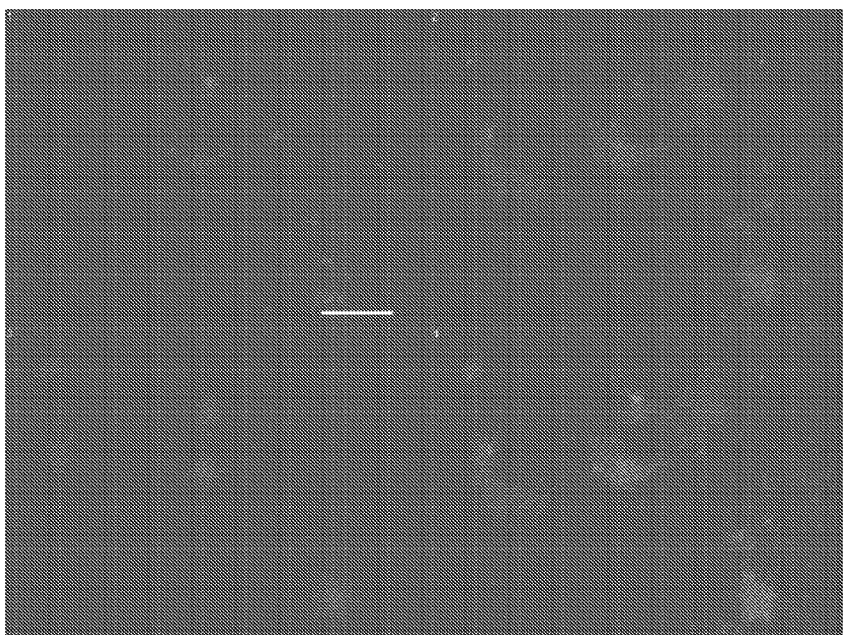
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, 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, PE, PG, PH, PL, PT, RO, RS, RU, 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, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, 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,

[Continued on next page]

(54) Title: MAGNETIC NANOSTRUCTURES AS THERANOSTIC AGENTS

Figure 36



(57) Abstract: The present invention relates to magnetic nanostructures as theranostic agents, which provide dual function as diagnostic and therapeutic agents. In particular, the present invention relates to compositions comprising magnetic nanostructures and their use as targeted therapeutic agents for cancers (e.g., medulloblastoma) and Alzheimer's disease and related diseases and conditions.

WO 2011/053901 A3



SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *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))*

Published:

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

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

29 September 2011

A. CLASSIFICATION OF SUBJECT MATTER*G01N 33/53(2006.01)i, G01N 33/574(2006.01)i, G01N 27/72(2006.01)i, A61K 49/16(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)

G01N 33/53; A61F 2/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: nanoparticle, radiofrequency, antibody, cancer

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	NAYAK, J. S. et al. 'Enhancing magnetic nanostructures for biomedicine.' Nanoscape, 2007, Vol. 4, Issue. 1, Pages 73-79. See the abstract, introduction, background and figure 1.	1-7
X	GANNON, C. J. et al. 'Intracellular gold nanoparticles enhance non-invasive radiofrequency thermal destruction of human gastrointestinal cancer cells.' Journal of Nanobiotechnology, 30 January 2008, Vol. 6, No. 2. See the abstract, introduction and discussion.	1-7
X	IVKOV, R. et al. 'Application of high amplitude alternating magnetic fields for heat induction of nanoparticles localized in cancer.' Clin. Cancer Res., 01 October 2005, Vol. 11, Pages 7093s-7103s. See the abstract, introduction and discussion.	1-7
X	HILGER, I. et al. 'Use of magnetic nanoparticle heating in the treatment of breast cancer.' IEE Proc. – Nanobiotechnol., February 2005, Vol. 152, No. 1, Pages 33-39. See the abstract	1-7



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

27 JULY 2011 (27.07.2011)

Date of mailing of the international search report

27 JULY 2011 (27.07.2011)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 189 Cheongsu-ro,
Seo-gu, Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

Kim, Jeong-Ah

Telephone No. 82-42-481-8747



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2010/054939**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.: 8-18
because they relate to subject matter not required to be searched by this Authority, namely:
Claims 8-18 pertain to methods for treatment of the human body by therapy, thus relate to a subject matter which this International Searching Authority is not required, under Article 17(2)(a)(i) of the PCT and Rule 39.1(iv) of the regulations under the PCT, to search.
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:

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.:

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/US2010/054939

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MORAN, C. H. et al. 'Size-dependent joule heating of gold nanoparticles using capacitively coupled radiofrequency fields.' Nano Research, May 2009, Vol2, No. 5, Pages 400-405. See the abstract	1-7
X	US 2006-0190063 A1 (JOHN KANZIUS) 24 August 2006 See the abstract	1-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2010/054939

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006-0190063 A1	24.08.2006	AU 2006-284974 A1	08.03.2007
		CA 2562625 A1	24.11.2005
		CA 2562625 C	19.01.2010
		CA 2620795 A1	08.03.2007
		EP 1758648 A1	07.03.2007
		EP 1933940 A1	25.06.2008
		JP 04-579975 B2	03.09.2010
		JP 2007-536016 A	13.12.2007
		JP 2009-505795 A	12.02.2009
		JP 2010-167283 A	05.08.2010
		US 2003-0066690 A1	10.04.2003
		US 2004-0084227 A1	06.05.2004
		US 2005-0251233 A1	10.11.2005
		US 2005-0251234 A1	10.11.2005
		US 2005-0273143 A1	08.12.2005
		US 2006-0065450 A1	30.03.2006
		US 2007-0093881 A1	26.04.2007
		US 2007-0250139 A1	25.10.2007
		US 6639158 B2	28.10.2003
		US 6936776 B2	30.08.2005
		US 7151232 B2	19.12.2006
		US 7510555 B2	31.03.2009
		US 7627381 B2	01.12.2009
		US 7910841 B2	22.03.2011
		WO 2005-110261 A2	24.11.2005
		WO 2005-110544 A1	24.11.2005
		WO 2005-118065 A2	15.12.2005
		WO 2005-120639 A2	22.12.2005
		WO 2007-027620 A1	08.03.2007