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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
6 January 2011 (06.01.2011)

PCT

(10) International Publication Number
WO 2011/002537 A3

(51) International Patent Classification:
G01T 1/167 (2006.01) *G01T 1/169* (2006.01)

(21) International Application Number:
PCT/US2010/030455

(22) International Filing Date:
9 April 2010 (09.04.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/167,902 9 April 2009 (09.04.2009) US

(71) Applicant *(for all designated States except US)*: **BOSS-DEV, INC.** [US/US]; 700 Tower Drive, Suite 500, Troy, MI 48098 (US).

(72) Inventor; and
(71) Applicant : **NORRIS, Wayne, B.** [US/US]; 2534 Murrell Road, Santa Barbara, CA 93109-1859 (US).

(74) Agents: **SHACKELFORD, Jon, E.** et al.; Dickinson Wright PLLC, 38525 Woodward Avenue, Suite 2000, Bloomfield Hills, MI 48304-5092 (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 (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, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

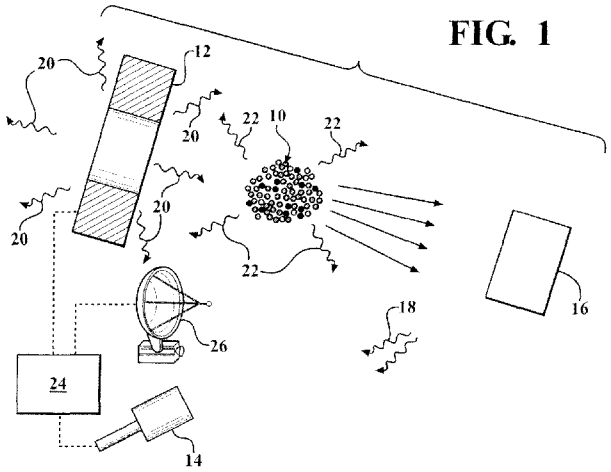
— *with international search report (Art. 21(3))*

— *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))*

(88) Date of publication of the international search report:
31 March 2011

(54) Title: NEUTRON FLUORESCENCE WITH SYNCHRONIZED GAMMA DETECTOR

FIG. 1



(57) Abstract: Method and apparatus for minimizing signal noise (20, 22) in thermal, epithermal, and cold neutron fluorescence processes using neutron flux modulation and gamma ray detector pulse gating synchronized to neutron time of flight (NTOF). The apparatus includes a source (12) of thermal, epithermal, and/or cold neutrons, optionally switched between flux or power settings in various embodiments, a gamma ray detector (14) or detection system capable of either being turned ON and OFF, in some embodiments, or else being told to regard or disregard gamma ray signals (20, 22) in other embodiments, a control mechanism (24), and either a target range detector (26) or a prior measurement of target range, in embodiments where the range remains fixed. The gamma ray detector (14) is synchronized to the NTOF by the control mechanism (24) so that it remains switched OFF during the pulse period of the neutron source (12) and for the subsequent NTOF so that any nuisance signals (20, 22) arriving at the detector (14) during these times are not detected or considered.

WO 2011/002537 A3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2010/030455

A. CLASSIFICATION OF SUBJECT MATTER

G01T 1/167(2006.01)i, G01T 1/169(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)

G01T 1/167; G01N 23/20; G21G 1/06; G01T 1/161; G01T 1/00; G01T 1/164; G21H 5/00; G01N 23/223

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: neutron, signal noise, detector

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2004-0036025 A1 (WAI-HOI WONG et al.) 26 February 2004 See paragraph 75-98; claim 1-15; figures 1-5B.	1-20
A	US 4987582 A1 (WEBSTER; JACKIE R. et al.) 22 January 1991 See column 3, line 7-59; claim 1; figures 1-2.	1-20
A	US 5078952 A1 (GOZANI; TSAHI et al.) 07 January 1992 See column 5, line6-31; figures 1,4.	1-20
A	US 2005-0135534 A1 (JAMES JONES et al.) 23 June 2005 See paragraph 31; claim 11; figures 1,3.	1-20
A	US 4882121 A1 (GRENIER; GERARD) 21 November 1989 See column 3, line 26-47; claim 1.	1-20

☐ 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	Date of mailing of the international search report
21 JANUARY 2011 (21.01.2011)	**25 JANUARY 2011 (25.01.2011)**

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

AHN, Young Woong

Telephone No. 82-42-481-8720

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2010/030455

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004-0036025 A1	26.02.2004	CA 2463756-A1	15.05.2003
		EP 1444534 A2	11.08.2004
		US 2002-0121603 A1	05.09.2002
		US 6310349 B1	30.10.2001
		US 6525322 B2	25.02.2003
		US 6936822 B2	30.08.2005
		WO 03-040757 A2	15.05.2003
		WO 03-040757 A3	15.05.2003
US 4987582 A1	22.01.1991	EP 0423763 A2	24.04.1991
		EP 0423763 A3	11.09.1991
		EP 0423763 B1	18.05.1994
		JP 06-054296 B2	20.07.1994
		JP 3140851 A	14.06.1991
US 5078952 A1	07.01.1992	CA 2060647 C	21.08.2001
		EP 0295429 A2	21.12.1988
		EP 0295429 A3	18.01.1989
		EP 0295429 B1	15.01.1992
		EP 0476070 A1	25.03.1992
		EP 0476070 A4	04.05.1994
		EP 0476070 B1	21.08.1996
		JP 01-092648 A	11.04.1989
		JP 02-697794 B2	19.09.1997
		JP 2697794 B2	14.01.1998
		KR 10-1996-0016334 B1	09.12.1996
		US 5006299 A1	09.04.1991
		US 5114662 A1	19.05.1992
		US 5153439 A1	06.10.1992
		WO 90-16072 A1	27.12.1990
US 2005-0135534 A1	23.06.2005	US 2007-0274426 A1	29.11.2007
		US 7142625 B2	28.11.2006
		WO 2005-047852 A2	26.05.2005
		WO 2005-047852 A3	19.04.2007
		WO 2005-047852 A3	26.05.2005
US 4882121 A1	21.11.1989	EP 0227497 A1	01.07.1987
		EP 0227497 B1	16.01.1991
		EP 0227497 B2	02.02.1994