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H01L 51/05 (2006.01) *H01L 51/00* (2006.01)
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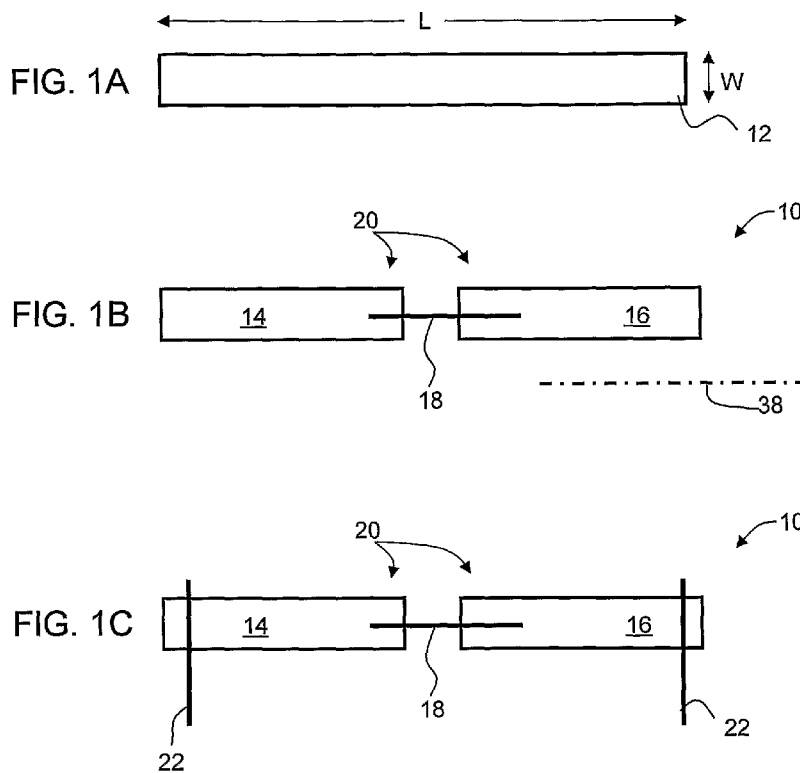
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[Continued on next page]

(54) Title: RECTIFYING ANTENNA DEVICE WITH NANOSTRUCTURE DIODE



(57) Abstract: A rectifying antenna device is disclosed. The device comprises a pair of electrode structures (14,16), and at least one nanostructure diode (12) contacting at least a first electrode structure of the pair and being at least in proximity to a second electrode structure of the pair. At least one electrode structure of the pair receives AC radiation, and the nanostructure diode (s) (18) at least partially rectifies a current generated by the AC radiation.



- (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, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
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A. CLASSIFICATION OF SUBJECT MATTER
 INV. H01L31/0232 H01L31/0352 H01L29/06 H01L51/05 H01L29/86
 H01L27/28 H01Q1/24 H01Q9/28
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 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)
 H01Q H01L

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, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2004/034473 A2 (UNIV COLORADO [US]; WEISS MANOJA D [US]; ELIASSON BLAKE J [US]; MODDEL) 22 April 2004 (2004-04-22)	1,3-6,9, 11, 13-15, 17,19, 24,26-28
Y	paragraphs [0032] - [0038] paragraphs [0026] - [0028] figures 2,3	2
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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	*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 document 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	

Date of the actual completion of the international search 27 July 2010	Date of mailing of the international search report 06/08/2010
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Weis, Thomas
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INTERNATIONAL SEARCH REPORT

International application No

PCT/IL2009/000722

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 3 970 839 A (JAVAN ALI) 20 July 1976 (1976-07-20) figures 6-8,25a,26-28 column 8, line 5 - column 9, line 30 column 11, line 57 - column 12, line 5 column 15, line 3 - column 16, line 40 -----	1,3-6, 11,13, 19, 21-24, 26-28 2
X A	US 2007/240757 A1 (REN ZHIFENG [US] ET AL) 18 October 2007 (2007-10-18) cited in the application paragraphs [0042] - [0044] paragraphs [0052] - [0055] paragraphs [0058], [0 60]; figure 1 figures 1,8,11 -----	1,5,6, 13,27,28 3,4
X A	MAYER A ET AL: "Three-dimensional analysis of the geometrical rectifying properties of asymmetric metal-vacuum-metal junctions and extension for energy conversion" PHYSICAL REVIEW B (CONDENSED MATTER AND MATERIALS PHYSICS) AMERICAN PHYSICAL SOCIETY BY AIP USA, vol. 77, no. 8, 15 February 2008 (2008-02-15), pages 085411-1-085411-11, XP002591400 ISSN: 1098-0121 pages 085411-2, column 1, paragraph 1 pages 085411-5, column 1, lines 5-27 Section V figures 1,6 Section C -----	1,5, 7-10,13, 15,17, 20-28 11
X	SULLIVAN T E ET AL: "PROPOSED PLANAR SCANNING TUNNELING MICROSCOPE DIODE: APPLICATION AS AN INFRARED AND OPTICAL DETECTOR" IEEE TRANSACTIONS ON ELECTRON DEVICES, IEEE SERVICE CENTER, PISACATAWAY, NJ, US LNKD- DOI:10.1109/16.43769, vol. 36, no. 11, 1 November 1989 (1989-11-01), pages 2659-2664, XP000098407 ISSN: 0018-9383 page 2659, column 2, lines 4-11 Sections II, VII and VIII figure 8 ----- -/--	1,5,7,8, 10,27,28

INTERNATIONAL SEARCH REPORT

International application No

PCT/IL2009/000722

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CORKISH R ET AL: "Solar energy collection by antennas" SOLAR ENERGY, PERGAMON PRESS. OXFORD, GB, vol. 73, no. 6, 1 December 2002 (2002-12-01), pages 395-401, XP004421963 ISSN: 0038-092X Sections 2, 4.2, 4.3 -----	1,3,4
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A	EP 1 699 088 A1 (FUJI XEROX CO LTD [JP]) 6 September 2006 (2006-09-06) paragraphs [0013] - [0029] paragraphs [0121] - [0131] paragraphs [0231] - [0234] paragraphs [0293] - [0307] figures 1,2,10 -----	1,5,7,8, 20,21
A	US 2006/261433 A1 (MANOHARA HARISH [US] ET AL) 23 November 2006 (2006-11-23) paragraphs [0004] - [0008] paragraphs [0041] - [0043], [0068] figures 1,2 -----	1,5,6,21
E	WO 2009/152435 A1 (CUTLER PAUL H [US]) 17 December 2009 (2009-12-17) ----- page 8, line 5 - page 10, line 4 figures 1,2 -----	1,3,6, 13-15, 17,21, 27,28

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL2009/000722

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:

see additional sheet

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 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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 2-6, 19(completely); 1, 11, 13, 23, 24, 27, 28(partially)

A rectifying antenna device comprising a pair of electrode structures and at least one nanostructure diode contacting at least a first electrode structure of said pair and being at least in proximity to a second electrode structure of said pair and comprising at least one dielectric resonator for receiving and enhancing said AC radiation such that at least one electrode structure of said pair receives enhanced radiation.

2. claims: 7, 8, 10, 12, 18(completely); 1, 11, 13, 20-28(partially)

A rectifying antenna device comprising a pair of electrode structures and at least one nanostructure diode contacting at least a first electrode structure of said pair and being at least in proximity to a second electrode structure of said pair wherein said nanostructure diode is a nanoscopic-scale elongated structure; said electrode structures of said pair are substantially planar and are arranged in a partially overlapping manner, wherein the device further comprises a dielectric layer for ensuring that said electrode structures of said pair are devoid of electrical contact thereamongst, and wherein said at least one nanostructure diode contacts one electrode structure of said pair and overlaps the other electrode structure of said pair.

3. claims: 9, 14-17(completely); 1, 13, 20-28(partially)

A method of manufacturing a rectifying antenna device, comprising depositing a first electrode structure on a substrate, depositing a second electrode structure on said substrate, so as to form a pair of electrode structures being at least partially exposed and devoid of contact thereamongst; and depositing at least one nanostructure on an exposed part of at least one of said pair so as to form at least one nanostructure diode contacting at least a first electrode structure of said pair and being at least in proximity to a second electrode structure of said pair; providing an additional electrode structure and applying electric field to said additional electrode structure so as to burn a tip of said at least one nanostructure diode, hence to prevent contact between said at least one nanostructure diode and said second electrode structure.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IL2009/000722

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