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(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, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, 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.

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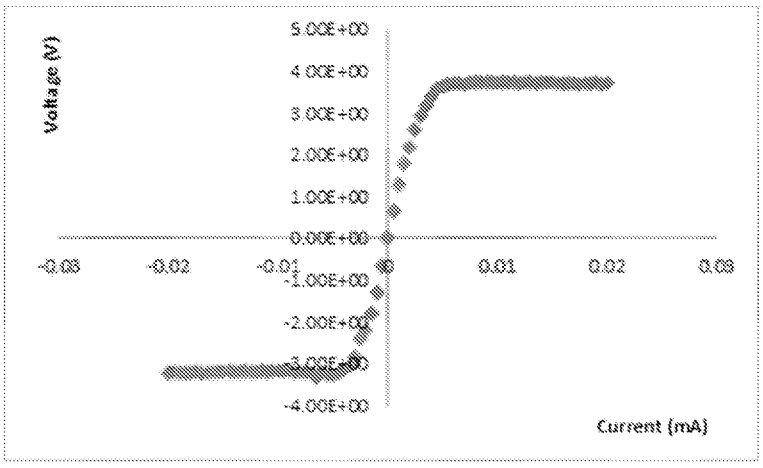
Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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:
17 October 2019 (17.10.2019)

(54) Title: SUPERCONDUCTING COMPOUNDS AND METHODS FOR MAKING THE SAME

Fig. 38C



(57) Abstract: A superconducting article includes a substrate and a superconducting metal oxide film formed on the substrate. The metal oxide film including ions of an alkali metal, ions of a transition metal, and ions of an alkaline earth metal or a rare earth metal. For instance, the metal oxide film can include Rb ions, La ions, and Cu ions. The superconducting metal oxide film can have a critical temperature for onset of superconductivity of greater than 250 K, e.g., greater than room temperature.

WO 2019/116103 A3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB18/01574

A. CLASSIFICATION OF SUBJECT MATTER

IPC - H01L 39/00, 39/02, 39/12 (2019.01)

CPC - H01L 39/00, 39/12, 39/125, 39/128, 39/2422, 39/2448

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)
See Search History document

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	WO 2016/067205 A1 (QUANTUM DESIGNED MATERIALS LTD.) 06 May 2016; abstract; page 1, lines 5-8, 27-28; page 2, lines 1-12; page 7, lines 12-13; page 21, lines 22-28; page 32, lines 9-11; page 32, lines 9-11; page 41, lines 1, 11; claims 1-3, 7, 10, 18	72-73, 74/72-72, 75-76 -- 1-2, 3/1-2, 13-14, 15/13-14
Y	WO 2010/071364 A9 (UP CHEM CO LTD) 02 September 2010; see machine translation; abstract; claims 1, 8, 13; page 4, third, seventh and tenth paragraphs; page 8, first and fourth paragraphs; page 13, fourth paragraph	1-2, 3/1-2, 13-14, 15/13-14
Y	US 8,784,936 B2 (XU, C et al.) 22 July 2014; column 8, lines 29-35	14, 15/14
E, X	WO 2019/116103 A2 (QUANTUM DESIGNED MATERIALS LTD.) 20 June 2019; entire document	1-2, 3/1-2, 13-14, 15/13-14, 72-73, 74/72-73, 75-76

☐ 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
"D" document cited by the applicant in the international application
"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 another 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
27 June 2019 (27.06.2019)	29 AUG 2019
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. 571-273-8300	Authorized officer Shane Thomas Telephone No. PCT Helpdesk: 571-272-4300

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB18/01574

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.: 4-12, 16-29, 33-44, 48-64, 69-71, 77-78
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:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-2, 3/1-2, 13-14, 15/13-14, and 72-76 are directed towards a method using atomic layer deposition.
Group II: Claims 30-31, 32/30-31, 45-46, and 47/45-46 are directed towards a method using molecular beam epitaxy.
Group III: Claims 65-67, and 68/66-67 are directed towards an electronic device comprising Josephson junctions that exhibits room temperature superconductivity.

-***-Continued Within the Next Supplemental Box-***-

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.:

1-2, 3/1-2, 13-14, 15/13-14, 72-73, 74/72-73, 75-76

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/IB18/01574

-***-Continued from Box III: Observations where unity of invention is lacking-***-

The inventions listed as Groups I-III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The special technical features of Group I include forming a superconducting metal oxide film on a substrate by atomic layer deposition, the forming including: exposing the substrate to one or more pulses of a reactant which are not present in Groups II-III; the special technical features of Group II include growing a superconducting metal oxide film on a substrate by molecular beam epitaxy (MBE), which are not present in Groups I and III; and the special technical features of Group III include an electronic device comprising Josephson junctions that exhibits room temperature superconductivity which are not present in Groups I-II.

The common technical feature of Groups I-III is a superconducting article.

The common technical feature is disclosed by Pellin, et al. (hereinafter "Pellin").

Pellin discloses a superconducting article (a high temperature device formed by atomic layer deposition; title; abstract).

Since the common technical feature is previously disclosed by Pellin, these common feature is not special and so Groups I-III lack unity.