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[Continued on next page]

(54) Title: ACTIVE MATERIAL FOR RECHARGEABLE BATTERY

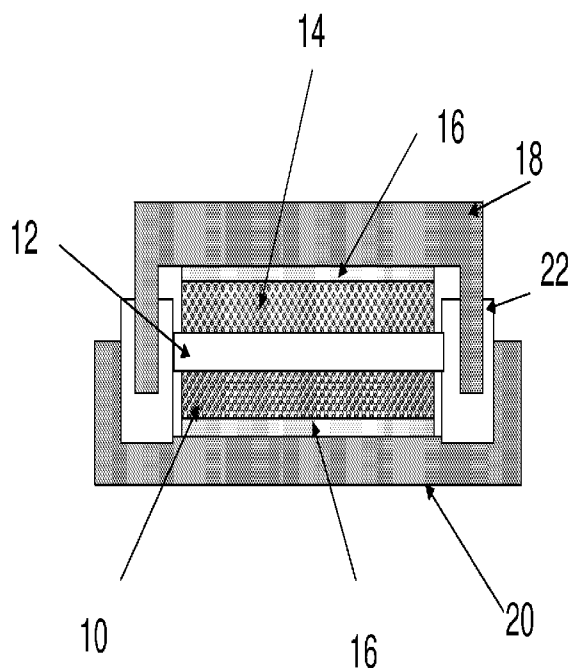


FIG.-1

(57) Abstract: A magnesium battery includes a first electrode including an active material and a second electrode. An electrolyte is disposed between the first electrode and the second electrode. The electrolyte includes a magnesium compound. The active material includes an inter-metallic compound of magnesium and antimony. The active material also includes antimony or an alloy of bismuth and antimony.



(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, 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, 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:

28 February 2013

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/039046**A. CLASSIFICATION OF SUBJECT MATTER****H01M 4/38(2006.01)i, H01M 10/05(2010.01)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)

H01M 4/38; H01M 10/40; H01M 4/46; H01M 4/62; H01M 6/16; H01M 10/36; H01M 10/26; H01M 4/58

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: magnesium, antimony, electrode, bismuth, titanium, platinum

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	EP 2287957 A1 (SONY CORPORATION) 23 February 2011 See abstract, paragraphs [0001]-[0309], claims 1-20, figures 1-27.	1,3-5,8,10-12 2,6-7,9,13-36
Y	HONDA, HITOHIKO et al., "Anode behaviors of magnesium-antimony intermetallic compound for lithium secondary battery", Journal of power sources, Vol. 123, PP. 216-221, 20 September 2003 See abstract, pages 216-221.	1,3-5,8,10-12
Y	US 2010-0136438 A1 (NAKAYAMA, YURI et al.) 03 June 2010 See abstract, paragraphs [0053]-[0058], figure 1.	1,3-5,8,10-12
Y	JP 2009-064730 A (SONY CORP.) 26 March 2009 See abstract, paragraphs [0001]-[0086], claims 1-25.	1,3-5,8,10-12
A	US 2001-0049060 A1 (AURBACH, DORON et al.) 06 December 2001 See abstract, figures 1-2, paragraphs [0001]-[0089], claims 1-27.	1-36

☐ 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

18 DECEMBER 2012 (18.12.2012)

Date of mailing of the international search report

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Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/039046

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:

Group 1: Claims 1-14 relate to a magnesium battery, comprising an active material including an inter-metallic compound of magnesium and antimony.

Group 2: Claims 15-36 relate to a magnesium battery, comprising an active material including an alloy of bismuth and antimony.

The common technical features among groups 1-2 are a magnesium battery, comprising an active material including antimony. However, these features lack novelty and/or inventive step with respect to the following documents:

a) US 2001/0049060 A1, b) US 6316141 B1

Thus there is no technical relationship left over the prior art among groups 1-2, leaving groups 1-2 without a single general inventive concept.

Hence, there is lack of unity of invention (PCT Rule 13.1 and 13.2).

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

Information on patent family members

International application No.

PCT/US2012/039046

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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