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(54) Title: POROUS SILICON BASED ANODE MATERIAL FORMED USING METAL REDUCTION

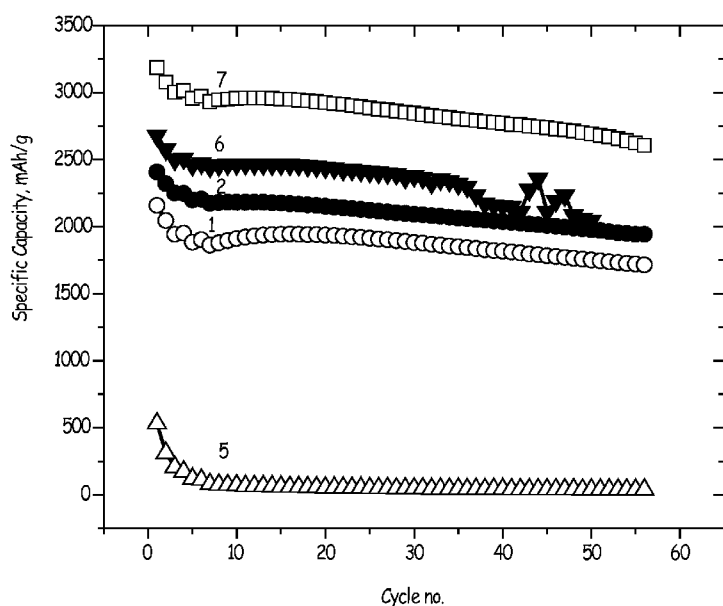


FIG. 6a

(57) Abstract: A porous silicon based material comprising porous crystalline elemental silicon formed by reducing silicon dioxide with a reducing metal in a heating process followed by acid etching is used to construct negative electrode used in lithium ion batteries. Gradual temperature heating ramp(s) with optional temperature steps can be used to perform the heating process. The porous silicon formed has a high surface area from about 10 m<sup>2</sup>/g to about 200 m<sup>2</sup>/g and is substantially free of carbon. The negative electrode formed can have a discharge specific capacity of at least 1800mAh/g at rate of C/3 discharged from 1.5V to 0.005V against lithium with in some embodiments loading levels ranging from about 1.4 mg/cm<sup>2</sup> to about 3.5 mg/cm<sup>2</sup>. In some embodiments, the porous silicon can be coated with a carbon coating or blended with carbon nanofibers or other conductive carbon material.

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**A. CLASSIFICATION OF SUBJECT MATTER****H01M 4/134(2010.01)i, H01M 4/525(2010.01)i, H01M 4/58(2010.01)i, H01M 10/0525(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 4/134; H01M 4/36; H01M 4/62; H01B 1/24; H01M 4/04; C01B 33/023; H01M 4/58; H01M 4/525; H01M 10/0525

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) &amp; Keywords: porous,silicon,crystalline,x-ray,amorphous,peak,carbon,discharge,cycle,lithium,silicon dioxide,metal oxide

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2011-053736 A1 (RICE UNIVERSITY et al.) 5 May 2011 See paragraphs [0019] - [0021]; and claims 1, 3, 5.	1, 2, 16, 17
Y		3, 18
A		19-21
Y	US 2011-0111294 A1 (LOPEZ, HEMAN A. et al.) 12 May 2011 See paragraphs [0077], [0078], [0083], [0084], [0086], [0087], [0092], [0094], [0097], [0113], [0148] - [0150], [0160]; and claims 16, 20, 21, 28.	3, 18
X	US 2011-0085960 A1 (MUKASYAN, ALEXANDER et al.) 14 April 2011 See abstract; and paragraphs [0020], [0021], [0024], [0026].	19-21
A	US 7776473 B2 (ARAMATA, MIKIO et al.) 17 August 2010 See abstract; column 5, lines 44 - 55 and claim 1.	1-3, 16-21
A	US 2009-0029256 A1 (MAH, SANG-KOOK et al.) 29 January 2009 See abstract; paragraph [0055]; and claim 1.	1-3, 16-21

 Further documents are listed in the continuation of Box C. See patent family annex.

\* Special categories of cited documents:

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**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

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