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— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

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(54) Title: CARBON NANOTUBE AUGMENTED ELECTRODES WITH SILICON

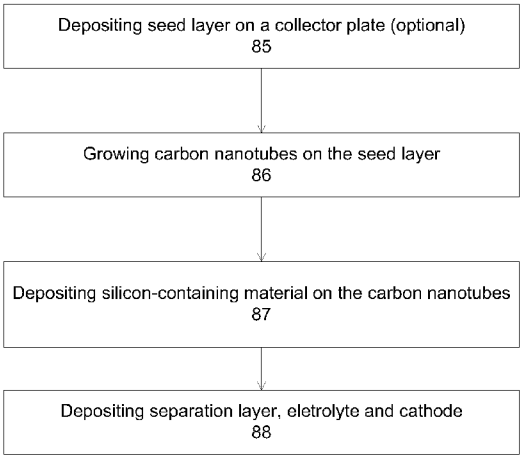

Fig. 8A

(57) Abstract: An electrode for a battery is augmented with vertically aligned carbon nanotubes, allowing both improved storage density of lithium ions and the increase electrical and thermal conductivity. Carbon nanotubes are extremely good electrical and thermal conductors, and can be grown directly on the electrode (e.g., anode or cathode) current collector metals, allowing direct electrical contact. Additionally carbon nanotubes have an ideal aspect ratio, having lengths potentially thousands of times as long as their widths, 10 to 1,000 nanometers. In an embodiment, the carbon nanotube electrode (e.g., an anode) comprises a silicon matrix, allowing withstanding volumetric changes exhibited during cycling of the electrochemical cell. In an embodiment, the carbon nanotube electrode (e.g., a cathode) comprises embedded sulfur, allowing both the improved retention of elemental sulfur and increase electrical conductivity.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

H01M 4/04(2006.01)i, B82B 3/00(2006.01)i, C23C 16/00(2006.01)i, H01M 4/583(2010.01)i, H01M 4/38(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)

H01M 4/04; H01M 4/00; H01M 4/60; B32B 37/00; H01M 4/66; H01M 4/96; H01M 4/88; 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: carbon nanotube, augment, vertical, silicon, deposit, seed, electrode, lithium battery

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2009/0075157 A1 (PAK, CHAN-HO et al.) 19 March 2009 See abstract, paragraphs 44-50, 91-115, claims 1-10	1-20
A	YUAN, LIXIA et al., 'Improvement of cycle property of sulfur-coated multi-walled carbon nanotubes composite cathode for lithium/sulfur batteries' Journal of Power Sources, 15 April 2009, Vol. 189, Iss. 2, Pages 1141-1146 See abstract, figure 1, pages 1142-1143	1-20
A	US 2007/0134555 A1 (REN, ZHIFENG et al.) 14 June 2007 See abstract, figure 1, claims 1-20	1-20
A	US 2004/0241532 A1 (KIM, YOUNG NAM) 02 December 2004 See abstract, claims 1-22	1-20
A	US 6194099 B1 (GERNOV, YORDAN M. et al.) 27 February 2001 See abstract, claims 1-47	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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