

Anode Material for Secondary Battery Technology and Market Forecast

<https://marketpublishers.com/r/A570DC0E7BCEN.html>

Date: November 2010

Pages: 147

Price: US\$ 3,450.00 (Single User License)

ID: A570DC0E7BCEN

Abstracts

The graphite carbon has a layered, planar structure composing graphene layers that hexagonal network planes composed with carbon atoms of sp^2 hybrid orbital. The gap between graphene layers is united by Van der Waals power.

The graphite carbon means hexagonal graphite that the graphene layers are formed by ABAB..... way in c-axis direction. In the other hand, the rhombohedral graphite structure is partially layered by ABCABC..... way due to changed order of layering. The figure 2.2 shows the unit cell structure of rhombohedral graphite and hexagonal graphite.

The graphite crystal has crystallographic structure composing edge plane, which is parallel to c-axis direction, and basal plane, which is vertical in C-axis direction. Due to this structure, the graphite crystal has an anisotropy physical characteristic.

Also, the structural anisotropy characteristic of graphite carbon affects the electrochemical reaction in negative pole (anode) of Li-ion battery. The basal plane is relatively inactive about electrochemical reaction while the edge plane is very strong active. Therefore, the electrochemical is affected by relative ratio of basal and edge plane in graphite carbon. So because of the strong reaction of graphite carbeneous edge plane, it is easy to absorb surface group including oxygen in the air.

Mesophase pitch is formed as intermediate phase while the isotropy melting pitch or is formed by extracting from the pitch that is made by selective extraction. In the figure 2.14, the extracted spherical mesophase by pyrolysis of pitch is generally called as 'Brooks-taylor type'. During pyrolyzing the pitch, if the proper size (10-30 micrometer) of round bids are became, the pitch is cooled and mesophase bids are separated by

dissolving the proper solvent. Then heat-treatment for graphite is implemented after forming the surface protective film by heat treatment of mesophase bids in the air mixed with oxygen and moisture. The graphitized MCMB, which is made by this way, is spherical particle as you can see in the figure 2.15 and shows outstanding characteristic of anode material for lithium secondary battery.

When electrode is manufactured, the spreading process is convenience because of the spherical particles. The high energy density of battery can be obtained by high electrode density and also declines in irreversibility capacity can be reduced with small specific surface.

It is easy to insert lithium and is shown outstanding rate features when charging/recharging because most surfaces of MCMB are composed with edge-plane surface of graphite

However, it is not well-used currently because of the need for heat treatment at high temperature and large amount of solvent uses.

As the new anode material for high capacity lithium secondary battery, the characteristics required for anode material instead of conventional graphite is similar with the following conditions of anode material replacing lithium metal.

If charging or recharging, insert Li-ion and lithium metal for electric potential of recession.

Less difference with potential. This is for having high battery voltage when composing battery and positive/negative poles.

Have high charge/recharge capacity rather than graphite (Capacity per unit weight and capacity per unit volume)

Less loss of initial irreversibility.

Outstanding charging/recharging cycle characteristics.

High ion diffusion velocity and electrical conductivity in active materials.

Maintain the structural stability of electrode because of less change in volume by Lithium insertion/secession.

Be easy to manufacture and low cost.

The typical high capacity metal atoms, Si, Sn, Sb, and Al are known for formation of lithium-metal alloy by reaction with lithium. The figure 3.1 and 3.2 represents the theoretical lithium storage capacity and electric potential range of lithium reaction with those metal atoms. Most of metal reaction electric potential is below 1V compared with lithium metal electronic potential. In particular, Si has similar reaction electric potential with graphite carbon. Those metallic atoms show high lithium storage capacity rather than graphite.

In particular, Si has high capacity over 4000 mAh/g theoretically. But if considering weight and volume after lithium reaction, graphite carbon is less changed whereas the capacity of high capacity atoms, Si and Sn, are largely reduced. This is because great changes in bulk happen when high capacity metal reacts with lithium. The figure 3.3 represents the volume changes before and after reacting with lithium, showing 10% of the volume change of graphite while 300% volume change of Si.

Si/Sn (Silicon/Tin) and LTO are used, mostly Si/Sn are usually called as metallic. As mentioned, the development and research on non-carbon is ongoing. The capacity of carbon is 350mAh/g whereas the non-carbon (Si 4,000mAh/g, Sn 994mAh/g, Al 993mAh/g, Silica Li_2SiO 850~1,200mAh/g and Metal Lithium 3,860mAh/g) has 10 times higher capacity so it is very attractive for electric vehicles and high-power secondary battery.

Anode material for Li-ion secondary battery is expected to be increased about 2.2 times with annual 17.3% growth rate, starting from 19,412 tons in 2009 to 43,120 tons in 2014

Strong Point

The world first report specialized in anode materials for Li-ion secondary battery

Carbon and Non-carbon anode materials technology and Recent forecast of Industries

Reports to give the direction of future business of anode materials

Contents

1. INTRODUCTION

- 1.1. Lithium metal secondary battery and Li-ion battery
- 1.2 Lithium-metal anode
- 1.3 Requirements for Lithium metal alternative anode material
- 1.4 The current statue of development of carboneous for anode
- 1.5 The current statue of anode material development

2. CARBONEOUS MATERIAL FOR ANODE

- 2.1 Carboneous material outlook
 - 2.1.1 Combining form of carbon atoms
 - 2.1.2 Manufactures of Carbon
- 2.2 Soft-Carbon anode materials
 - 2.2.1 Graphite
 - 2.2.1.1 Structure
 - 2.2.1.2 Electrochemical
 - 2.2.1.3 Electrode reaction machine
 - 2.2.1.4 Graphite carboneous making method and commercial graphite
 - 2.2.1.4.1. Artificial graphite
 - 2.2.1.4.2 Natural graphite
 - 2.2.2 Low temperature Co-fiered Carbon
 - 2.2.2.1 Structure
 - 2.2.2.2 Electrochemical
 - 2.2.2.3 Electrode reaction machine
 - 2.2.2.4 Manufacturing method
- 2.3 Hard-Carbon anode materials
 - 2.3.1 Non-graphitizable carbons
 - 2.3.1.1 Structure
 - 2.3.1.2 Electrochemical
 - 2.3.1.3 Electrode reaction machine
 - 2.3.1.4 Manufacturing Process

3. METALLIC ANODE MATERIAL

- 3.1 Metallic anode material outlook
- 3.2 The characteristics of metallic anode material and manufacturing technique

- 3.2.1 Problems and Solutions
- 3.2.2 Metal composite anode material
- 3.2.3 Metal ??Carbon composite anode material
 - 3.2.3.1 Carbon coating of high capacity reactive metal and alloy
 - 3.2.3.2 High capacity active metal and alloy/graphite carbon mixed complexes
 - 3.2.3.3 Carbon coating of high capacity active metal and alloy/graphite carbon mixed complexes
 - 3.2.3.4 Metalizing Si into graphite and carbon nano
- 3.2.4 Other Si anode materials
 - 3.2.4.1 3-Dimension porose Si
 - 3.2.4.2 Si Nano tube
- 3.2.5 Metal / Alloy thin-film anode material

4. COMPOUND ANODE MATERIAL

- 4.1 Oxides anode material
 - 4.1.1 $\text{Li}_4\text{Ti}_5\text{O}_{12}$ (or $\text{Li}_4/3\text{Ti}_5/3\text{O}_4$)
 - 4.1.2 TiO_2
 - 4.1.2.1 Rutile TiO_2
 - 4.1.2.2 Anatase TiO_2
 - 4.1.2.3 $\text{TiO}_2\text{-B}$
 - 4.1.2.4 Brookite
- 4.2 Nitrides anode material

5. ANODE EFFECTS ON SAFETY OF LI-ION BATTERY

6. ANODE MATERIAL INDUSTRIES FOR LITHIUM SECONDARY BATTERY

- 6.1 Japan anode material Industries
 - 6.1.1 Hitachi Chemical
 - 6.1.2 Nippon Carbon
 - 6.1.3 JFE Chemical
 - 6.1.4 Mitsubishi Chemical
 - 6.1.5 Hitachi Powdered Metals HITASOL
 - 6.1.6 Other anode material industries in Japan
- 6.2 China anode material Industries
 - 6.2.1 BTR Eneregy Materials Co., Ltd.
 - 6.2.2 Shanghai Shanshan Tech Co., Ltd.
 - 6.2.3 Changsha Hairong New Materials Co., Ltd

6.3 Korea anode material Industries

6.3.1 OCI Materials

6.3.2 Posco Chem Tek

6.3.3 GS Caltex

6.3.4 Other domestic anode material Industries

6.4 Other anode material industries

6.4.1 TIMCAL Graphite & Carbon

6.4.2 ConocoPhilips

7. ANODE MATERIAL FOR LITHIUM SECONDARY BATTERY MARKET FORECAST (2009~2014)

7.1. Lithium secondary battery market forecast (2009~2014)

7.2. Li-ion battery manufacturing cost and anode materials

7.3. The current statue and forecast of anode material market by types

7.4. The current statue and forecast of anode material market by industries

7.5. The current statue and forecast of anode e material market by countries

7.6. Direction of further anode material market

8. REFERENCE LIST

I would like to order

Product name: Anode Material for Secondary Battery Technology and Market Forecast

Product link: <https://marketpublishers.com/r/A570DC0E7BCEN.html>

Price: US\$ 3,450.00 (Single User License / Electronic Delivery)

If you want to order Corporate License or Hard Copy, please, contact our Customer Service:

info@marketpublishers.com

Payment

To pay by Credit Card (Visa, MasterCard, American Express, PayPal), please, click button on product page <https://marketpublishers.com/r/A570DC0E7BCEN.html>

To pay by Wire Transfer, please, fill in your contact details in the form below:

First name:
Last name:
Email:
Company:
Address:
City:
Zip code:
Country:
Tel:
Fax:
Your message:

****All fields are required**

Customer signature _____

Please, note that by ordering from marketpublishers.com you are agreeing to our Terms & Conditions at <https://marketpublishers.com/docs/terms.html>

To place an order via fax simply print this form, fill in the information below and fax the completed form to +44 20 7900 3970