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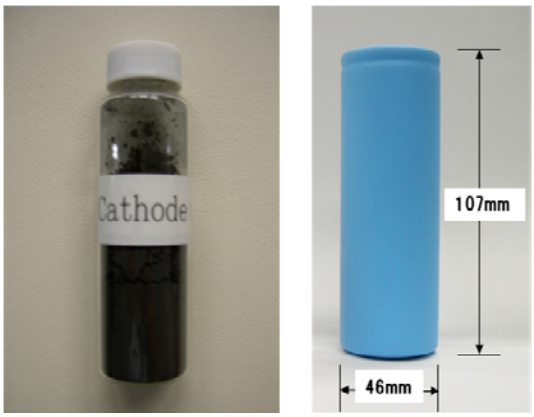
Hitachi develops new technology that doubles the life of industrial lithium-ion batteries using manganese-based cathode materials



Left : The newly developed manganese-based cathode material
Right: A lithium-ion cell using the new manganese-based cathode material
(prototype jointly developed by Hitachi and Shin-Kobe Electric)

Tokyo, April 5, 2010 --- Hitachi, Ltd. (NYSE:HIT/TSE:6501,hereinafter Hitachi) today announced that Hitachi has developed a new cathode material for industrial lithium-ion batteries using manganese-based cathode materials that roughly doubles the life of similar batteries using the cathode material which was developed by Hitachi in the past. The newly developed cathode material, made from manganese, a resource in abundant supply, stabilizes the crystal structure by replacing some of the manganese in the cathode material with other elements, and at the same time includes composite oxides[*1] with outstanding resistance to acids, to minimize the elution of manganese into the liquid electrolyte[*2]. Hitachi has already developed and evaluated[*3] prototype cells using the new cathode material, and has confirmed that reductions in battery capacity can be roughly cut in half compared to existing units. Using the new material, Hitachi thus expects to be able to achieve battery life of ten years or more, which is about twice the life of current lithium-ion batteries with manganese-based cathode materials.

Lithium-ion batteries using the newly developed cathode material are expected to be used for electrical power storage in wind power generation and other new energy fields, and as industrial power sources for electric-powered construction machinery designed to reduce greenhouse gas emissions.

These results were achieved as part of an ongoing project contracted by the New Energy and Industrial Technology Development Organization (NEDO) to Hitachi under the title “Development of elemental technologies for power storage systems to achieve smooth utility

interactions.” The prototype cell was developed in collaboration with Shin-Kobe Electric Machinery Co., Ltd.

Lithium-ion batteries are used in a wide range of applications, including mobile phones, laptop PCs, and other consumer products, as well as hybrid automobiles and other vehicle applications. In the future, they are expected to be used as compact storage devices in connection with wind power generation and other power facilities designed to reduce environmental impact. Cobalt is the main cathode material used in lithium-ion batteries for consumer applications, which is currently the largest market for these batteries. The growing popularity of lithium-ion batteries, however, has given rise to concerns regarding the ability to a secure stable supply of cobalt, which is a scarce resource. Hitachi turned its attention to manganese, which is available in abundant supply, as a candidate metal that could replace cobalt as the main cathode material, and has been conducting research and development targeting lithium manganese spinel[*4] materials, which have a “spinel structure”[*5]. The high operating voltage of spinel makes this material suitable for power storage applications, but a number of challenges remained, including the deterioration of battery capacity over numerous charge and discharge cycles. The focus of attention thus turned to improving battery life characteristics.

Hitachi minimized changes in the volume of spinel crystals during charge and discharge by replacing some of the manganese in the lithium manganese spinel with other elements, thereby successfully controlling reductions in battery capacity. Furthermore, the inclusion of layered composite oxides with outstanding acidity resistance reduces the elution of manganese into the liquid electrolyte. It is therefore possible to prevent reductions in battery capacity, which had been a problem in the past, and to increase battery life. Following are the main features of the newly developed technology.

1. Replacing some of the manganese with other elements stabilizes crystal structure and minimizes reductions in battery capacity

In the case of existing lithium manganese spinel cathode materials, lithium ions are released from the cathode during battery charging, causing shrinkage in the volume of the spinel manganese crystals. During battery discharge, however, the crystal volume tends to swell. This repeated change in volume during charge and discharge cycle results in a deterioration of the crystal structure, which is one cause of reduced battery capacity. By replacing some of the manganese in the crystal with other elements, the crystal structure has been stabilized, and reductions in the battery’s capacity have been dramatically improved.

2. Inclusion of composite oxides reduces manganese elution, thus minimizing reductions in battery capacity

When using existing lithium manganese spinel cathode materials, the effects of acids generated by water in the liquid electrolyte cause the manganese to dissolve (a process called “elution”), which results in reduced battery capacity. Now, along with the lithium manganese spinel material in which some manganese has been replaced with other elements, Hitachi has added a new layered composite oxide with outstanding acidity resistance, thereby reducing manganese elution and minimizing reductions in battery capacity.

This newly developed cathode material for lithium-ion batteries uses manganese, a resource available in abundant supply, as its main material, so a stable supply can be achieved at low cost. In the future, Hitachi will continue to increase battery performance through further improvements to cathode materials and electrolyte composition, in order to actively expand its rechargeable battery product business, and to contribute to reducing environmental impact.

Notes: *1 Composite oxide: An oxide containing two or more types of metal elements
*2 Liquid Electrolyte: A solution that demonstrates electrical conductivity, formed by dissolving an lithium salt in a polar solvent
*3 This evaluation was based on tests conducted under standard test conditions for NEDO contracted research
*4 Lithium manganese spinel: An oxide compound with a spinel structure, containing lithium (Li) and manganese (Mn) (chemical formula: $LiMn_2O_4$)
*5 Spinel structure: A crystal structure that is common to inorganic compounds with the molecular form $(A)(B)_2O_4$, as in the case of spinel ($MgAl_2O_4$), which is a naturally occurring mineral

About Hitachi, Ltd.

Hitachi, Ltd., (NYSE: HIT / TSE: 6501), headquartered in Tokyo, Japan, is a leading global electronics company with approximately 400,000 employees worldwide. Fiscal 2008 (ended March 31, 2009) consolidated revenues totaled 10,000 billion yen ($102.0 billion). The company offers a wide range of systems, products and services in market sectors including information systems, electronic devices, power and industrial systems, consumer products, materials, logistics and financial services. For more information on Hitachi, please visit the company's website at http://www.hitachi.com.

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