Next-generation battery

High performance next generation Na-ion battery – free from rare or poisonous elements

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Purpose of Research

In the 1980's, secondary batteries with metallic lithium were commercialized as power sources with high voltage and large capacity. However, since the lithium metal anode was highly reactive, advanced technology had been required to solve the safety issue without sacrificing the benefits of this system. In 1991, the Japanese company Sony released the first commercial lithium-ion (Li-ion) battery in which lithium metal was replaced by carbon materials, and it has been become an essential power source for various equipment from portable electric devices including mobile phones to large applications such as electric vehicles and home stationary backup power system. The Li-ion battery is now a promising candidate to be a part of grid energy storage incorporated with wind and solar power systems. However relatively expensive Li-price hampers to realize this system because an extremely large battery is needed and cost reduction becomes the priority rather than performance. In addition, deposits of lithium are concentrated in a few locations in the world and Japan completely relies on imports from North/South America and China. Thus, an alternative to lithium is greatly desired for large-scale battery, and the Na-ion battery is now attracting much attention as a feasible technology since sodium is abundant everywhere on earth.

Summary of Research

Points
- No toxic elements
- Low cost and high power storage capacity
- Fast discharge and recharge

Our laboratory developed a 3 V-class Na-ion battery that uses $Na[Ni_{1/2}Mn_{1/2}]O_2$ as the positive electrode and hard carbon as the negative electrode. This battery is capable of operating at room temperature without any hazards and its energy density has reached 60–80% that of widely used graphite/$LiCoO_2$ batteries.

Na belongs to the alkali metal group in the periodic table, just below Li, and has weaker Lewis acidity and lower electrostatic interaction with negative charge than Li, resulting in faster Na^+ migration in the electrode, electrolyte and interface. Thus, the Na-ion batteries have the potential to realize ultrafast charge/discharge operation. This is one of the advantages of the Na-ion batteries and they contentiously demonstrate tremendous results, making them the likely choice for the next generation secondary battery.

Future Developments

Develop scarce-metal free Na-ion batteries for commercialization as high power storage devices, with financial support from Japanese government and the cooperation of industries.

- Grant Program: JSPS Funding Program for Next Generation World-Leading Researchers
- Awards: The 11th JSPS Prize (FY2014)
- Intellectual Property: WO2012/060295 "COMPOSITE METAL OXIDE, PROCESS FOR PRODUCING THE COMPOSITE METAL OXIDE, POSITIVE ACTIVE MATERIAL FOR SODIUM SECONDARY BATTERY, POSITIVE ELECTRODE FOR SODIUM SECONDARY BATTERY, AND SODIUM SECONDARY BATTERY"
- Prototype: Present
- Sample: Available

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