Tailored surface modification on porous SiO as an anode material for Lithium ion rechargeable battery

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Abstract

The current level of performances of Lithium Ion Batteries (LIBs) is not enough to meet commercial demands for new applications(xEV, ESS), in particular, with respective to energy density. Graphite and hard carbons are commonly used as a negative electrode material for LIBs, but higher-capacity alternatives are being consistently sought due to their limited capacity as an anode material of next generation LIBs for large-scale power applications. Recently, various Si, and Sn based compound including transition metal oxide, multiphase alloy, and intermetallic compounds have been extensively studied as alternatives to the existing carbon based anode material. These materials show much higher capacities than those of carbonaceous material. However, they are suffering from huge lattice volume change (>300%) through conversion reaction mechanism during Li insertion, which results in poor cycle life of LIBs.

In this respect, metal phosphides have been alternatively suggested as a promising anode material for their reversibility, and large amount of lithium uptake at relatively low potential. Obviously, the degree of difference in electronegativity between constituting elements inevitably dtermines whether the metal phosphides obey topotactic reaction mechanism during lithiation and delithiation, which can be readily understood by considering the Gibbs formation free energy [1,2]. Basically, the metal rich phosphides have physical properties similar to those of ordinary metallic compounds like the carbides, nitrides, borides and silicides. They combine the properties of metals and ceramics, and thus are good conductors of heat and electricity, are hard and strong, and have high thermal and chemical stability [3,4].

In this work, we have synthesized new Si composite anode involving metal phosphide with topotatic reaction mechanism, while relating with electrochemical properties. We finally propose newly designed anode composed of metal phosphide based Silicon composite showing long durability and less swelling properties.

Keywords: *Metal phosphide, Silicon oxide, Anode, Li-ion, Rechargeable battery*

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Biography

Dr. Lee works as a leader and a Principal Researcher in Battery Research Center at KERI. Dr. Lee has received Ph.D. in Electrochemistry from Korea Advanced Institute of Science and Technology (KAIST) and has 20-year career in battery research field. His major research fields are focused on development of next generation anode material for Li-ion rechargeable battery, especially Si based metal anode system. He has also been interested beyond Li-ion battery system with higher energy density.