The Effect of Commercialized Binders on Silicon Oxide Anode Material for High Capacity Lithium ion Batteries

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The lithium insertion/extraction properties of silicon oxide (SiO_x) composite electrode are investigated using polyvinylidene fluoride (PVDF), LA132 (which major copolymerization chain is polyacrylonitrile-polyacrylic acid (PAN-PAA)) and polyacrylic acid (PAA). Electrochemical cycling tests show that SiO_x electrode with conventional binder PVDF results in rapid capacity fading, while aqueous binders LA132 and PAA remarkably improve the cycle performance of SiO_x at a current density of $80 \text{ mA} \cdot \text{g}^{-1}$. SiO_x electrode with PAA delivers a reversible capacity up to $1090 \text{ mAh} \cdot \text{g}^{-1}$ after 50 cycles. All of the electrodes after 10 cycles exhibiting a huge expansion of surface morphology, and some crevices are observed in SiO_x -PVDF electrode. Results of Fourier Transform Infrared Spectroscopy (FTIR) and X-ray diffraction (XRD) show that amorphous or little crystalline grain structure and ester-like bonds are the key factors of adhesion property for binders in SiO_x composite electrode. With cycling, impedance of the SiO_x electrodes with different binders is increasing severely. In addition, the differential capacity plots are used to explain the capacity fading mechanism, the kinetics of electrode process of SiO_x are not affected by applying different binders.

Keywords: Lithium ion battery, Si-based, SiO_x , Binder, High capacity anode

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