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Book of Abstracts

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Electrochemical study of Li-ion intercalation into anatase TiO_2 nanotubes at different temperatures

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Lithium-ion batteries (LIBs) are the most promising energy storage devices on the market today. Their importance is reflected in the fact that LIBs power numerous portable devices and that they are being developed for electric and hybrid electric vehicles [1]. Most commercial LIBs are composed of a graphite anode, which cannot meet high performace requirements [2]. Several transition metal-oxide based hosts have been considered as potential alternatives to the graphite anode, including TiO_2. Low cost, high Li-ion insertion potential, low volume expansion and good cycling life make TiO_2 a promising anode material. Different polymorphs of TiO_2 have been investigated, and preference is given to the anatase phase. Herein, anatase TiO_2 nanotube arrays (NTAs) electrode was preapred by anodic oxidation of Ti-foil and subesquent annealing at 400 ^oC. SEM micrographs show that the nanotubes (NTs) are cylindrical in shape, with an average inner diameter of about 95 nm and wall thickness ~15 nm. In the Raman spectrum, five active modes which correspond to the anatase phase are present. XRD pattern of as-prepared Ti/TiO_2 NTAs electrode was recorded, and the strongest diffraction maximum of anatase phase was used for the claculation of the mean crystallite size. The obtained value is 19 ± 1 nm. Electrochemical experiments, which included cyclic voltammery (CV), electrochemical impedance spectroscopy (EIS) and galvanostatic (GS) cycling, were carried out using a termostat in the temperature range from 25 – 55 ^oC. The 1 M solution of $LiClO_4$ in propylene carbonate was used as an electrolyte in all cases. CV experiments demonstrated an increase in the redox peak intensity and a decrease in peak-to-peak separation at higher temperatures, indicating improvement in Li-ion storage capability and better reversibilty of Li-ion intercalation/deintercalation process. GS cycling showed a large Li-ion insertion capacity of Ti/TiO_2 NTAs electrode, high Coulombic efficiency (CE) and good capcity retention. Lithiation capacity at 55 ^oC attains 357 $mAh \cdot g^{-1}$ at current rate 5.3 C, with CE of 97.5% and capacity retention of 98.5% after 50 cycles. EIS showed with increasing temperature a multifold decrease in solid electrolyte interphase (SEI) layer resistance and charge transfer resistance. EDS and FTIR spectra of Ti/TiO_2 NTAs electrode were recoreded to better underastand the nature of the formed SEI film.

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