Fe3O4-based Cu nanostructured electrode for Li-ion battery

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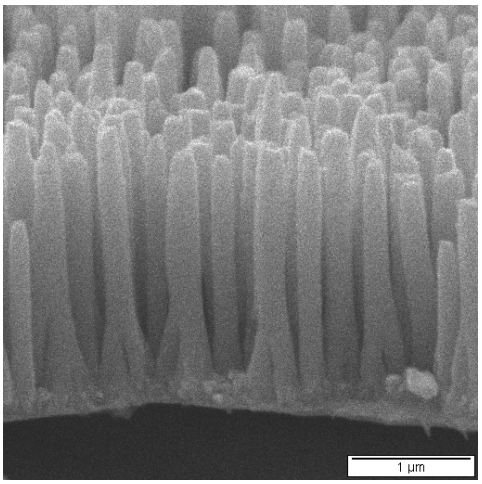
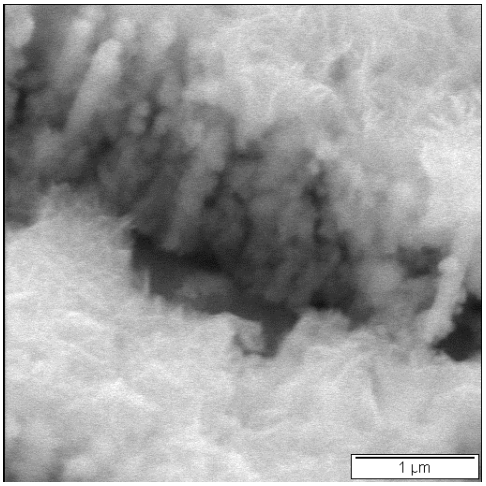
Developing Li-ion batteries with high specific capacities and high current densities as power sources for many applications is of great interest. Seeking a suitable electrode material is critical to achieve that goal. In the work, Fe3O4-based Cu nanostructured electrodes for Li-ion cells are fabricated by a two-step electrochemical process. Cu-nanorod arrays acting as current collectors are first prepared on a thin copper disk by alumina template assisted electrodeposition. The active material of Fe3O4 is electrochemically deposited onto Cu nanorod arrays by potentiostatic deposition. X-ray diffraction identifies textured growth for both the Cu nanorods and Fe3O4. Scanning electron microscopic observation further reveals that the active material are deposited between Cu nanorods, and a 30 second deposition of Fe3O4 is sufficient to fill up the inter-rod space under the currently employed conditions. Longer electroplating time leads to the coalescence of Fe3O4 particles and the formation of bulky Fe3O4 islands on the top of the Cu nanorods. Electrochemical properties of the nanostructured electrodes are studied by conventional charge/discharge tests. The results show that the rate capabilities of the nanostructured electrodes are better compared to those of the planar electrodes and the coalescence of Fe3O4 particles is detrimental to achieve sustained reversible capacities.



Cross-section SEM image of Cu nanorod arrays as the current collector



Oblique SEM image of Fe3O4 deposit on Cu nanorod arrays

TiO2-based Cu nanostructured electrode for Li-ion battery

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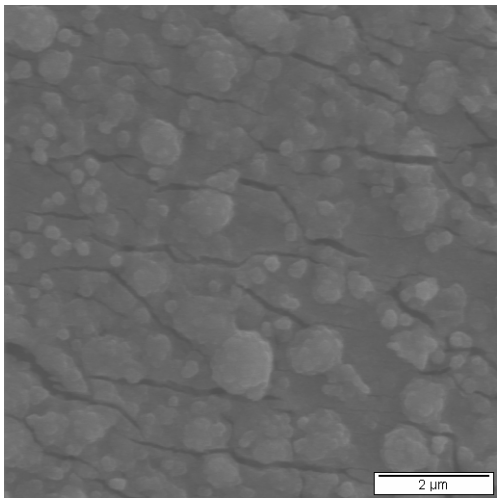
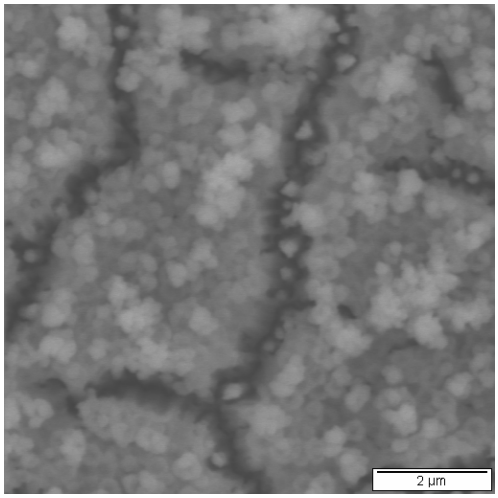
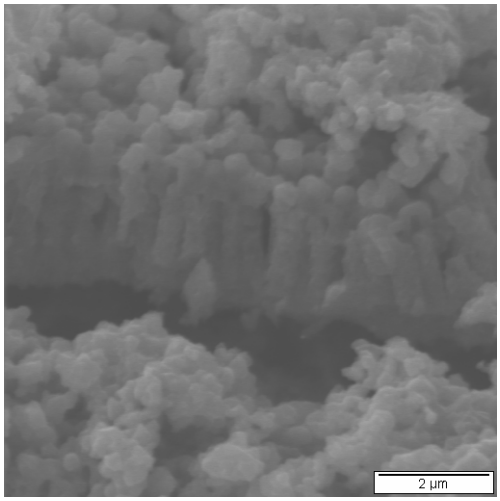
TiO2 has been found to be an attractive anode material due to its high capacity, high mechanical stability during Li intercalation/deintercalation process, limited side reactions with the electrolyte, low cost, and environmental friendliness. In this study, TiO2 films on various copper substrates are prepared from acidic aqueous solutions of TiOSO4 and H2O2 by potentiostatic cathodic electrosynthesis. Different Cu substrates include planar Cu disc, mechanically polished planar Cu disc, and Cu nanorod arrays grown on Cu disc. Cyclic voltammetry (CV) has been employed to study the electrochemical redox reactions in this system. The CV scan results show a big and sole cathodic peak in the potential range of -700 ~ -850mV, corresponding to the formation of titanium hydroxide gel. The electrodeposited gel films are annealed at 400 ^{o}C in argon atmosphere to obtain crystalline TiO2 films. The morphology and microstructure of the TiO2 films are characterized by scanning electron microscope (SEM) and X-ray diffraction (XRD). SEM results show that the deposits on planar Cu surfaces have a macro-particulate structure and those on Cu nanorod arrays are composed of nanoparticles with particle size around 100 nm.



TiO2 deposits on planar Cu disc



Top view SEM image of TiO2 deposits on Cu nanorod arrays



Oblique view SEM image of TiO2 deposits on Cu nanorod arrays