Abstract

Electrical Transport in 2-Naphthylacetylene Anode of Li+ Ion Battery in Strong Inhomogeneous Electric Field by UHV STM/AFM

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2-Naphthylacetylene (2-NA) polymer is one the most attractive conductive polymer for the anode of rechargeable battery based on the *p*-conjugation in the main chain. 2-NA polymer exhibits new advantages: excellent processability, solubility and stability. These properties could complement now the advantages of polyacetylenes known before: high power density, high energy density, and low weight. First task solved in present work was to prove the ability of 2-NA polymer to incorporate Li and work as anode. Second task solved was the study of stimulated electron and ion transport in polymer by a strong and inhomogeneous electric field. This electric field can be created by voltage applied to nanometer-scale clusters deposited on the very thin film of electrically conductive polymer. The probe of UHV Scanning Tunneling Microscope (STM) was used in present work as a model of a single cluster. Strong electric field allowed visualization of low conductive polymer in STM experiment and provided high current density in thin film battery. The multi-layer Li ion rechargeable thin film battery with 2-NA polymer anode, glass electrolyte, and Li intercalated V_2O_5 cathode was prepared. The battery was studied in situ by low current UHV STM/AFM layer by layer. Spatial variations of current through the polymer anode were observed at two polarities of voltage with molecular resolution. STM tip contacted mechanically to the surface of the anode. Cycling of virgin polymer by alternating positive and negative voltage with zero final charge on the battery revealed structure of ordered fibrils in current image of the polymer. Conductivity increased by a factor of 3 due to structural changes in the polymer. The polymer anode of the battery was prepared and studied by STM in an initially discharged state. At the final stage of experiment the polymer was covered with a collector. The whole battery was charged to a voltage of 2.5 V and its conductivity increased by a factor of 10^5 due to Li intercalation of the anode.

¶Presenter