Thin Film Deposition of Positive Electrodes for All-Solid-State Li-ion Microbatteries Based on TiO_2 Nanotubes

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Nowadays, microbatteries are in demand as a power source to satisfy the market requirements with fast development of microelectronic devices such as miniaturized and smart devices, Internet of Things… which require new power solutions due to the conventional batteries simply won't meet the requirements for most of new products. As more energy is required, a shift to all-solid-state 3D architectures has been proposed as a promising approach to tackle the challenge and achieve both high energy and power densities [1]. Thus, microbatteries of various chemistries and structures have been developed or are under investigation. In 2009, our group proposed to use self-organized TiO_2 nanotubes (TiO_2nts) as a 3D negative electrode to improve the electrochemical performance of Li-ion microbatteries [2]. The enhanced electrochemical performance utilizing TiO_2nts could be achieved due to their nanostructures which offer good rate capability, capacity and cycling performance. Then, in 2014 our group has reported for the first time the fabrication of all-solid-state microbatteries using TiO_2nts as anode, $LiNi_{0.5}Mn_{1.5}O_4$ (LNMO) as cathode, and a drop-casted layer of polymethyl methacrylate-polyethylene glycol (PMMA-PEG) acting as electrolyte and separator. The polymer-coated TiO_2nts were pressed together with LNMO deposited on the aluminum disk and the wire connections established at the back side of each current collector [3]. In this study, we propose other fabrication technique using cathodic sputtering to directly deposit the cathode material onto the polymer-coated TiO_2nts. In order to achieve this goal, prior to assembly the whole microbattery, it is necessary to investigate the materials to be used as cathodes, as the key to accomplish the construction of ideal 3D microbatteries and further boost their energy and power density.

We will present the fabrication of thin films cathodes prepared by cathodic sputtering. We will also show the influence of morphology, structure and chemical composition of the cathode material on the electrochemical performance of the batteries in terms of areal capacity, rate capability and capacity fading using cyclic voltammetry and galvanostatic cycling.

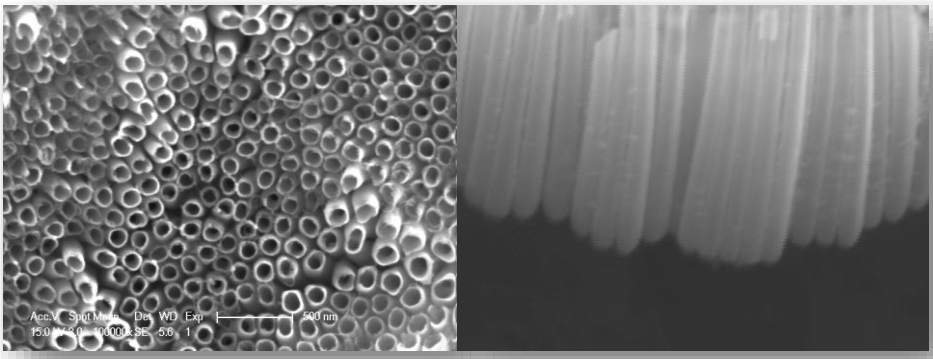

Figure 1: TiO_2 Nanotubes

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