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Nanoporous titania/silica hybrid electrodes for lithium ion batteries

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Light-weight, high energy density, stable and flexible solid-state lithium-ion micro batteries are of great importance due to its applications for miniature medical devices such as capsule endoscopes, implantable heart pumps and biosensors. However low energy density of commercial graphite anodes of lithium ion batteries limit their applications. Titania/silica ultrathin hybrid electrodes with different ratios have been designed aiming to obtain advantages of titania's high charge/discharge rate, stability and good cyclability as well as silica's high gravimetric capacity and low potential vs Li/Li+.
The hybrid electrodes are synthesized by sol-gel method. Simultaneously Polystyrene-block-polyethylene oxide (PS-b-PEO) diblock copolymer (DBC) was applied as a guiding template for production of nanoporous structure, which leads to higher charge/discharge rate. Spin-coating was then applied to obtain ultrathin film and samples were spin coated on silicon wafer and mica window following by calcination to remove DBC. Samples spin-coated on the mica windows are possible to be peeled off from mica window and get free standing ultrathin hybrid electrodes.
The electrodes coated on silicon wafers have been characterized by X-ray diffraction (XRD) and all peaks contributed from silicon, which suggested that the hybrid electrodes are in amorphous state.
Later on scanning electron microscopy (SEM) and small angle X-ray scattering (SAXS) will be applied for further investigation of nanostructure of the hybrid electrodes. Simultaneously the peeling off process needs to be improved to obtain entire electrode films. Finally the electrode will be coated of a layer of gold, assembled into liquid electrolyte lithium batteries and characterized of its capacity and cyclability.

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