Contribution ID: **64** Type: **Poster**

Highly-Regular Porous Antimony Oxide Thin Film Electrode for Rechargeable Batteries

Tuesday, 25 June 2019 16:15 (1 hour)

Due to limited supply of traditional fossil fuels, increasing carbon emission, and deteriorated environmental pollution, it is urgent for humankind to ensure alternative renewable energy sources. Because of high energy density, competitive working voltage, minimum self-discharge, and limited maintenance requirements, rechargeable lithium-ion batteries (LIBs) have been applied in various fields and regarded as the most promising power devices in the future. In recent years, the shortage of lithium source gradually became a noteworthy problem, which could limit the development of LIBs in next years. Since that sodium is an earth abundant material and sodium-ion batteries (SIBs) can meet these requirements better than LIBs, SIBs have come up as a more suitable alternative to LIBs for these applications[1]. Due to high theoretical capacity (Sb2O4 for 1220 mAh g-1, Sb2O3 for 1102 mAh g-1), appropriate reaction potential and abundant reserves in the earth crust, antimony oxides are regarded as a promising alternative anode materials which could be applied in both LIBs and SIBs[2]. However, antimony oxides suffer from volume expansion during charge and discharge, leading to a rapid capacity fading. Creating hollow or porous structure is an effective strategy to improve cycling stability of antimony oxides anodes, because it can provide enough void space to accommodate volume changes of antimony oxides[3].

Herein, we propose a novel method to synthesize highly-regular porous antimony oxide tin film anode materials assisted with block copolymer. Amphiphilic block copolymers (ABC) have been widely utilized as surface modification agents by constructing nanoscale architectures on various substrates through evaporation induced self-assembly processes[4]. Polymer/inorganic nanocomposites can be obtained via a microphase separation process in mixture solution of mixing block copolymer and precursor of metal oxide. Moreover, the morphology of nanocomposites could be controlled accurately by altering synthesis conditions[5]. After calcination, nanostructured metal oxide materials are gained. The morphology of as-prepared porous antimony oxide tin film anodes could be characterized by scanning electron microscopy (SEM) partially and grazing incidence small angle X-ray scattering (GISAXS) integrally[6]. Furthermore, in operando SAXS or Small-angle neutron scattering (SANS) measurements can be applied to investigated the evolving nanoscale morphology of electrode during charge and discharge processes[7, 8].

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Session Classification: Poster session