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Exploration of cathode materials for Li-S batteries via X-ray spectroscopy

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Recently, a lot of efforts have been devoted into lithium-sulfur (Li-S) battery system due to its high theoretical capacity (1675 mAh g-1) and low cost, which could be a competitive candidate for the next-generation batteries in the future. However, it suffers from a poor cycling stability during charging-discharging, which is blamed to the "shuttle effects"of lithium polysulfides [1]. Meanwhile, it is also challenging to reach a high capacity (≥1400 mAh g-1) for lithium sulfur batteries because of the insulated Sulfur and Li2S. In our study, functional metal oxide/metal sulfide/metal nitride nanoparticles with defined shape and composition have been designed and synthesized via colloidal approach using polymeric particles as soft template, which can be applied as electrode materials for Li-S batteries with significantly improved electrochemical performances [2-4].

In addition, fundamental understanding of the formation and dissolution processes of both solid phases, S8 and Li2S, is necessary for further improvement of the rate capability of Li-S cells. Synchrotron-based operando high-resolution X-ray imaging has been successfully used for the detailed morphology study of macroscopic sulfur particles during cycling of the battery cells [5]. And using small-angle X-ray scattering, a better understanding of the elucidation of structure-morphology-property-relationships promotes the development of carbon-based sulfur host materials [6]. More recently, we have developed MoS3-based freestanding cathode by deposition of MoS3/ polypyrrole (PPy) nanowires on the porous nickel foam via electrochemical methods. A mechanism study has been performed via taking advantages of this porous, binder-free, and free-standing cathode using X-ray absorption near edge spectroscopy (XANES) to investigate the evolution of the chemical and electronic structure of Mo and S species during discharge/charge processes. The formation of lithium polysulfides was excluded as the driving cathode reaction mechanism revealing the promising property of MoS3 as a sulfur-equivalent cathode material for Li-S batteries [4].

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I plan to submit also conference proceedings

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