Sn-MoS_2 Composite Fibrous Carbon Anodes for Sodium Ion Battery

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The growing demand for green energy opened doors for development and research of new technologies for energy storage. Among them, Na-ion is the most promising to replace the already commercialized Li-ion, due to its electrochemical equivalent and standard potential [1], plus the advantage of abundance and lower cost prime materials. Additionally, both technologies have similar working principle and production methodology. Literature reports on positive and negative electrodes for Na-ion batteries are usually analogues of those used in Li-ion battery [1].

Nanofibers, as 1D structures with specific properties that enable facile ion diffusion, traced electron transport and structural integrity during cycling are attractive materials. Their performances as electrodes for energy storage was already analyzed in various reviews [2–4] and in life cycle assessment studies [5], emphasizing their possible application. Despite of the various techniques can be used for production of nanofibers, in most of the studies electrospinning is the preferred one. On the other hand, techniques such as solution blowing or centrifugal spinning have been scarcely used despite of their advantageous production efficiency [6].

In this study we report production of composite carbon nanofibers (CNFs) via industrially scalable solution blowing method. Composite CNFs were produced by adding Sn and MoS_2 nanoparticles as active materials into polyacrylonitrile (PAN) solution. As prepared solution was spun on a lab-scale solution blowing device in order to obtain Sn/MoS_2/PAN nanofibrous mats. During the process, the polymer solution was delivered at a rate of 15 ml/h and compressed air at 3 bars was used to shape the polymer jet into fibrous form. The produced fibrous mats were further stabilized and carbonized to form Sn/MoS_2/CNFs. The morphology and structure of fibrous mats were characterized by SEM, FTIR and Raman spectroscopy. The CNFs were further used as free-standing anodes in a half cell Na-ion battery and their charge/discharge behavior was tested at different current densities. The results showed that the composite Sn/MoS_2/CNFs, produced by solution blowing method, are promising structures to buffer the volume expansion of the active material and to achieve cycling stability.

References:

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