Electrochemical Performance of Carbon/Sulfur as Lithium-Sulfur Battery Cathodes

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Nowadays, rechargeable batteries with higher energy density are required for our society due to the needs of cleaner and more efficient energy systems and with the objective of supplying the increasing technological demands. Commercial lithium batteries are systems based on intercalation compounds able to delivering specific energies about 150-200 $WhKg^{-1}$, one-third of their theoretical energy (≈ 600 Wh kg^{-1}). It is difficult for the reversible capacity of these intercalation compounds to be increased, thus the need to explore new cathodes formed by lighter materials and involving electrochemical reactions of more than one electron. An element satisfying these conditions is sulfur (with a theoretical capacity of 1675 $mAhg^{-1}$ and a specific energy of 2600 $WhKg^{-1}$).
The lithium-sulfur battery has been investigated by different groups in past decades; however, there are serious drawbacks, which have not been overcome yet, so it limits the practical development of this system [3]. Moreover, sulfur is much more abundant, inexpensive, and non-toxic compared to the transition-metal oxide cathodes.
We present here the preparation of composites with carbon and sulfur materials in a single fabrication process: using S_2C as the solvent. The characterization of the prepared material was performed using optical techniques (X-ray diffraction, scanning electron microscopy and transmission) and its electrochemical performance in lithium-sulfur batteries was studied using electrochemical techniques such as: charge-discharge cycles, galvanostatic discharges to different currents and cyclic voltammetry. The prepared composite materials delivered higher capacities in the first cycles (≈800 $mAhg^{-1}$) and then it were stabilized at values around 60% of the initial capacity. Also, carbon electrochemical response was not observed, so its main function is to act effectively as an electron-conducting and support matrix.

References

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