On the understanding and improvement of high capacity lithium/sulfur (Li/S) batteries

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Li/S batteries present many advantages including a high theoretical capacity (1675 $Ah \cdot kg^{-1}$), high energy density (2500 $Wh \cdot kg^{-1}$), and low cost of sulfur. However, degradation of the battery components at high cycle number and high discharge rates is still a problem. In this work, the investigations are focused on the understanding of the critical issues associated with the electrochemical and degradation processes occurring in Li-S batteries. For this, different characterization techniques and experimental procedures were studied: X-ray diffraction for detection and quantification of crystalline products Li_2S and S_8 [1], electrochemical impedance spectroscopy for analysis of electrolyte resistance, charge transfer resistance in the electrodes, and reaction and dissolution of Li_2S and S_8 [2], UV-Vis spectroscopy for detection and quantification of dissolved species (mainly polysulfides) [3], as well as thermal analysis (TG/DSC) and mass spectroscopy to study the degradation of components and morphological changes on the cathode.

The development of components and fabrication processes applicable at large-scale production and at low cost is also a great challenge for the commercialization of Li/S batteries. Here, we present developments related with the fabrication of industrially-oriented cathodes and the main factors affecting the battery capacity. Moreover, a new approach is investigated for the retention of active material in the bulk of the cathode.

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[2] N.A. Cañas, K. Hirose, N. Wagner, B. Pascucci, N. Wagner, K.A Friedrich, R. Hiesgen, Electrochim. Acta, 97 (2013) 42-51.

[3] N.A. Cañas, D. N. Fronczek, N. Wagner, A. Latz, K.A Friedrich, submitted to J. Phys. Chem. C.