Mechanism Panel Abstract & Speaker Biography

Effective Barriers for the Polysulfide Shuttle

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High-theoretical-energy-density Li/S batteries suffer from self-discharge, low cycle life and low coulombic efficiency. These are caused by large volume changes of the cathode occurring on charge-discharge, and the solubility of sulfur and of lithium polysulfides in battery electrolytes. The dissolved polysulfides damage the anodic solid electrolyte interphase (SEI), lead to corrosion of lithium and to the formation of shorter polysulfides. Short polysulfides, in turn, diffuse to the cathode, reoxidize and initiate a shuttle mechanism, followed by low energy-conversion efficiency. Research efforts have been made to prevent the escape of sulfur from the cathode by fabrication of different barriers to better separate the cathode from the anode.

In the current research, we study the effect of commercial carbon papers and home-made mixed conducting composites on the electrochemical performance of Li_2S/Li and S/Li cells. Modification of cell configuration by the insertion of Toray and SGL carbon papers between the cathode and separator improved the utilization of the active material and increased the reversible discharge capacity from 800 to 1250 and 1400mAh/gS, respectively. The latter is about 84% of the theoretical value. Moreover, the cells containing carbon interlayer papers exhibited a Faradaic efficiency (FE) of above 99%, while the FE of the cells with the unprotected cathode is 96%. The use of PEO-XC72 or LSPS-PEO-based very thin barriers, cast or electrophoretically deposited on the cathode or separator, resulted in a similar positive effect on the electrochemical performance of the cells. High Faradaic efficiencies confirm the functionality of barrier layers, which impede the polysulfide shuttle. Analysis of the impedance spectra of the conventional and modified cells show that the SEI resistance decreases from 155 to 11ohm.cm^2 and the apparent thickness of the SEI drops from 0.5 to 0.1nm in barrier-protected cells.

Speaker Biography:

Diana Golodnitsky holds an Associate Professor position at Tel Aviv University. She has been involved in the lithium battery research since 1992. Her major research activities are focused on the development of new nanosize electrode and solid-electrolyte materials with the use of versatile electrochemical approaches. Diana Golodnitsky's work has covered several topics related to the mechanisms of the electrochemical syntheses and ion conduction phenomena, composition- structure-properties correlation of the battery and supercapacitor materials.

Her scientific interests include, in addition, electrochemistry of metals and alloys, 3D-micro- and nano-battery architectures; characterization of innovative materials for advanced energy technologies using XRD, SEM, EDX, XPS, TOF SIMS, MDSC, and HRTGA-IR methods. She has authored over 100 papers, five book chapters, and over 200 conference publications; she holds 14 patents. She is a co-founder of 2 startup companies- Devis Electrocopy and Honeycomb microbatteries.