

Mechanism Panel Abstract & Speaker Biography

Lithium/Sulfur Battery Assembled in the Discharged State. The Effects of Binders and Cycling on Cell-Impedance Parameters and Fading

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The lithium/sulfur battery has many attractive properties and is a promising candidate for many applications. In addition to its high theoretical energy density (about 2600Wh/kg), it is made of relatively inexpensive and non-poisonous materials. Thus, it has attracted the attention of researchers for some years (1, 2). However, although much research has been carried out and many papers published, the processes responsible for capacity fading are not well understood. In addition to its attractive properties, the battery has several disadvantages, which include self-discharge, short cycle life and low coulombic efficiency. These may be caused by the low electronic conductivity of sulfur and its final discharge products, expansion of the cathode upon lithiation and the solubility of sulfur and of lithium polysulfides in battery electrolytes. Capacity fading on cycling may result from at least four processes: increase of SEI thickness resistance, loss of cathode capacity (precipitation of sulfur species outside the cathode), agglomeration and thickening of core-shell sulfur species and increase in cell impedance as a result of reduction of the electrolyte. A very important issue, that has not been properly addressed up to now, is the influence of type and concentration of cathode binder on the cell parameters and on the electrochemical performance of lithium/sulfur batteries. We present here a detailed analysis and discussion of the electrochemical behavior, during prolonged cycling, of Li₂S-based cathodes containing five different binders. With the use of electrochemical-impedance spectroscopy, we estimate the growth rate of the SEI resistance and thickness, its influence on the cathode charge-transfer reaction and on lithium diffusion. Depending on the type of binder, cells provide 500 to 1400mAh/g of sulfur, close to 100% faradaic efficiency and enable up to 1000 cycles.

References

1. H. Yamin and E. Peled; JPS 9, 281 (1983)
2. E. Peled, A. Gorenshtein, M. Segal and Y. Sternberg; JPS, 26, 269 (1989)

Speaker Biography:

Professor Emanuel Peled is the inventor and developer of the Solid-Electrolyte-Interphase (SEI) model for nonaqueous alkali-metal batteries. This model constitutes a paradigm change in the understanding of lithium batteries and has thus enabled the development of safer, durable, higher-power and lower-cost batteries.

He pioneered the development of several electrochemical systems including: lithium/sulfur battery, alkali-metal/air batteries, a very-low-cost nanoporous proton-conducting membrane (NP-PCM), a direct methanol fuel cell, a direct ethylene glycol fuel cell, hydrogen tribromide fuel cells and developed low-cost core-shell nanosize platinum-based catalysts. Emanuel Peled was a co-founder of three energy-related startup companies based on the technology developed in his laboratory.

