Additives Effect of Electrolyte on Electrochemical Reactions in Lithium-Sulfur Batteries

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Recently, as an alternative to Li-ion batteries, lithium-sulfur (Li-S) batteries have been considered as potential power sources for next-generation energy storage devices. Elemental sulfur (S_8), with an operating potential of ~2.1 V vs. Li/Li^+, accepts up to 16 electrons at room temperature. As a result, a sulfur cathode has a theoretical capacity of 1675 mAh g^{-1}, which can provide a high theoretical gravimetric energy density of 2600 Wh kg^{-1} for Li-S batteries. Moreover, sulfur can be readily obtained as a common by-product of the petroleum refining process, and it is an environmentally friendly element compared with certain toxic transition-metal compounds. Despite these advantages, several major issues must be solved prior to the practical use of Li-S batteries. The low intrinsic conductivity of sulfur (5×10^{-30} S cm^{-1} at 25 ^oC) and the intermediate products (polysulfides) result in unstable electrochemical contact at the sulfur cathode electrode. Furthermore, the dissolved polysulfides participate in shuttle reactions between the anode and cathode during the charge-discharge process [1]. These issues have definite effects on cycle life and system efficiency.
This study describes the relation between the cycling behaviors and formation of polysulfides in the presence of additives in organic electrolyte.

References:
[1] S. Yoon, Y.-H. Lee, K.-H. Shin, S.B. Cho, W.J. Chung, Electrochim. Acta 145 (2014) 170-176.