Highly sulfur-containing functionalized graphene derivatives as stable cathodes for Li-S batteries

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Lithium–sulfur (Li–S) batteries represent a low cost and high theoretical energy density "beyond Li-ion" technology and could fulfil the ever-growing requirements of electric vehicles and stationary energy storage systems [1]. However, the high lithium polysulfide solubility during sulfur conversion reaction in conventional liquid electrolytes results in the so-called shuttle effect of lithium polysulfides, which lowers the electrochemical performance of the Li–S batteries [2]. Thus, the development of novel, emerging cathodes using "protected" sulfur is needed. Moreover, in order to lower the capacity fade due to the shuttling effect the substitution of the single ethers solvent (such as dimethyl ether, DME) in the electrolyte with partially fluorinated ether is promising [3,4].
In this presentation, a novel method of sulfur functionalized graphene as a Li-S batteries cathode is proposed, in which the sulphur is covalently bonded on the graphene surface (figure 1). This approach except of the sulfur protection, also provides to high sulphur loading (80%wt.), which leads to high full cell mass capacity. Because of the high sulfur loading and the covalent bonding between the sulfur and the graphene matrix, the developed cathodes exhibit excellent performance, with satisfying sulfur utilization, high initial specific capacity and good rate capability at high charge/discharge current [5]. In addition, the substitution of the DME with a commercial available fluorinated ether, in combination with the covalent bonded sulfur, significantly increases the cathode's stability to ~725mAh.g^{-1} after 200 cycles even in low current rates (0.2C).

References

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Figures

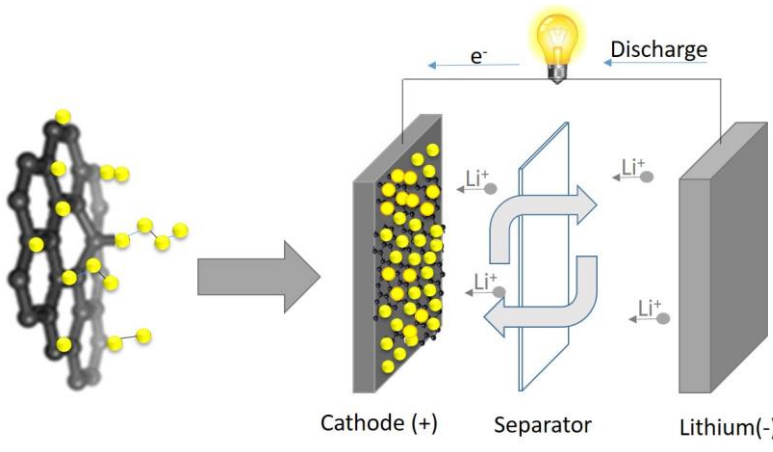

Figure 1: Sulfur functionalized graphene as an anode in Li-S batteries