Optimization of Lithium-Sulfur Battery Cathode: Role of Sulfur-Carbon Interaction

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The recently developed Lithium-Sulfur (Li-S) primary battery technology possess a theoretical energy capacity of 1600 mAh/g, which is significantly higher than any other battery on the market; however, due to polysulfide dissolution, Li-S batteries are unable to attain their optimum energy capacity and function as secondary rechargeable batteries. Throughout the course of this experimentation it was tested to see which individual functionalized Nano-Carbon morphology of Graphene, Multi-Walled Carbon Nanotubes (MWCNTs), or Graphene Nanoplatelets (GNP) prevents polysulfide dissolution and facilitates the creation of an optimum Li-S secondary battery. In order to facilitate sulfur functionalization, the nano-carbon materials were placed in a FeCl3 and Na2S suspension, with Triton X-100. The batteries were assembled in an Argon filled Glove Box with a lithium metal anode, optimized sulfur cathode, and Lithium-based electrolyte. The Arbin Battery Cycler data depicted that graphene functionalization, although providing the greatest initial energy capacity compared to other functionalized nano-carbon materials, was unable to prevent polysulfide dissolution throughout continuous charge and discharge cycles. Therefore in order to facilitate the further encapsulation of sulfur, graphene was mechanically mixed with Diphenyl Disulfide, which possesses only two atomic units of sulfur, creating π bonds with the hexagonal graphene crystalline structure, making polysulfide dissolution, chemically impossible. The resulting revolutionary Diphenyl Disulfide Lithium-Sulfur battery technology possess an energy capacity of over 1300 mAh/g, which is significantly higher than the market standard of 300, therefore making this technology truly revolutionary.

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