# Development and Optimization of High Energy Density Sodium-Sulfur Secondary Battery Technology: Attractive Alternative to Lithium

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The recently developed Lithium-Sulfur (Li-S) primary battery technology possess theoretical efficiencies of of 2.5V and a capacity of 1000 mAh g-1; however, these batteries are only limited to being primary due to a process called polysulfide dissolution. Therefore, the purpose of this research endeavor was to develop a develop a Sodium-Sulfur (Na-S) battery, containing MWCNTs and Graphene cathodes, that is cheaper and more efficient than the average electrochemical efficiencies of Li-S batteries. As well as create a Na-S secondary battery that overcomes the issue known as polysulfide dissolution through the use of the surfactant Triton X-100. The MWCNTs and the Graphene were functionalized with fluorine for 2 hours using a RF plasma system. The process of creating a CR2032 was begun by creating the cathode electrodes of the battery which were optimized using Triton X-100; then incubated in a vacuum oven for 2 hours. The batteries were assembled in an argon filled glove box with a Sodium metal anode, optimized carbon-sulfur cathode, and Sodium-based electrolyte. They were then placed into the battery testing instrument. The resulting data proved that it is possible to develop a Na-S battery as well as optimize and solve the problem of polysulfide dissolution through the use of Triton X-100. A Na-S battery using a Graphene cathode with Triton X-100 produced an initial voltage of 4.0V and an initial capacity of 2265 mAh/g; and MWCNTs cathode with Triton X-100 produced an initial voltage of 4.0V and an initial capacity of 2503 mAh/g.

**Awards Won:**