IV. Flexible High Capacity Li-S Batteries via Air-Controlled Electrospray of Highly Loaded Sulfur Solution

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The sulfur cathode has an astounding theoretical capacity of 1,675 mAh/g. In addition, sulfur is an inexpensive earth-abundant material, which makes it an even more attractive candidate as a cathode material. In this project in collaboration with EIC Labs, thin and flexible Li-sulfur/Li metal (or Si) battery with extremely high loading of sulfur (10 – 60 mg/cm^2) is devised via the air-controlled electrospray of sulfur solution into an asymmetric carbon membrane such as gas diffusion layer, as depicted in Fig. 4. While conventional drop cast and slurry coating methods consist of multiple steps including mixing, sonication, blading, calendaring, and long-time vacuum drying, the current approach of directly depositing sulfur into asymmetric membrane after dissolution into CS_2 by-passes those cumbersome steps. Once most of the sulfur goes into the porous membrane, the thin dense surface layer can prevent solidified sulfur from being leached during the charging/discharging processes, leading to the great capacity retention. For better rate capability, conductive carbon such as carbon black powder, reduced graphene oxides (rGO), carbon nanotubes (CNT), graphene nanoribbons (GNR) are be added to the C/CS_2 solution. In the project, the effect of carbon type and loading on the capacity and capacity retention will be examined and optimal composition for Li-S cathode materials will be proposed.

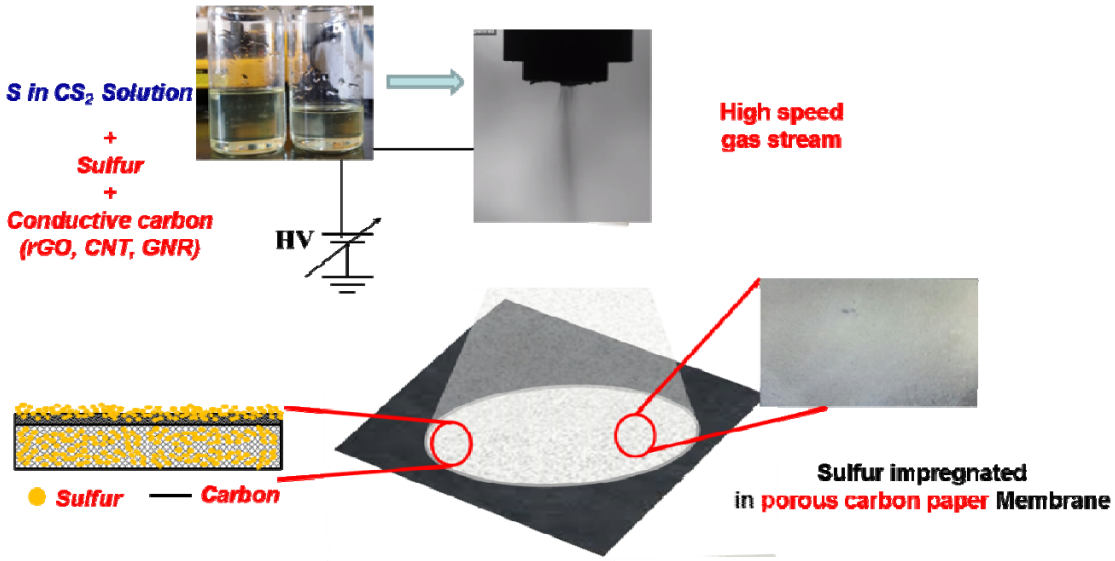

Fig. 4. *Schematic of preparation of a highly loaded Li-S cathode via air-controlled electrospray of S(+ rGO)/CS_2 solution*