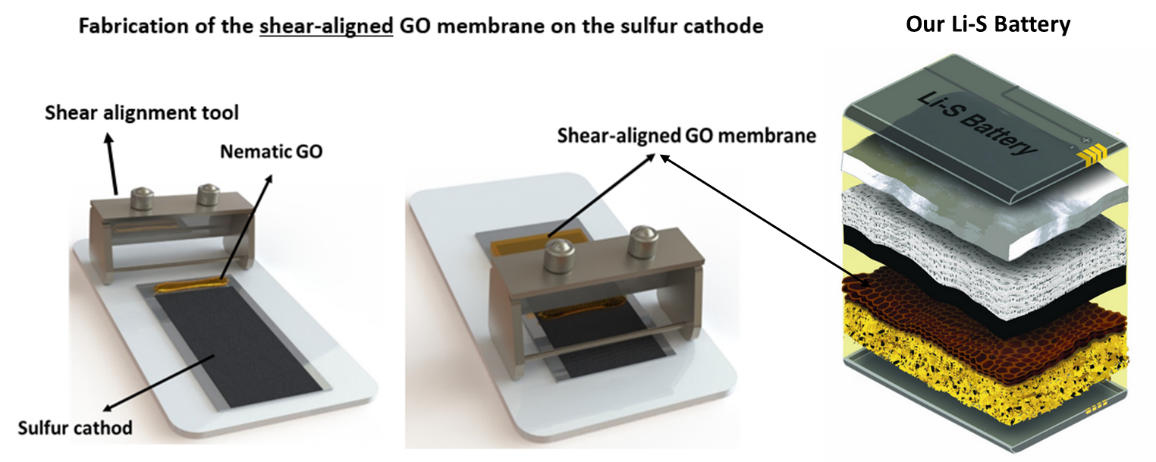
UG Scholarship Program - USTC

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**Project description**

Amongst various alternative rechargeable batteries, the Lithium-Sulfur (Li-S) couple with a theoretical specific capacity of 1675 mAh g-1 is a strong contender to outperform the Li-ion technology. However, Li-S batteries show poor cycle life, primarily due to the electrode dissolution in the electrolyte. Utilization of permselective membranes holds tremendous promise for retention of the electrode active material in electrochemical devises which suffer from electrode instability issues. Our research group has recently discovered a method for producing Graphene Oxide (GO) membranes and uncovered the role of structural order of shear-aligned GO membrane in dramatic enhancement of permeability.[[1](#_ENREF_1)] Built on that work we demonstrated the successful integration of a high-selectivity, ultra-thin graphene oxide membrane in Li-S battery which resolves this issue of electrode dissolution to a great extent and delivers properties close to those required for a practical rechargeable battery.[[2](#_ENREF_2)]

The fabrication and utilization of high content sulfur cathodes are yet to be explored in our Li-S system and are expected to bring potential breakthroughs to the field. In order to achieve competitive energy density values, we need to increase the sulfur content of the electrode. We have already increased the fraction of the sulfur in our electrodes up to 80 %, the main goal of our next stage of research would be to increase the areal loading of sulfur (mgs cm-2) as well. The main target and the most challenging part of this stage is to increase the areal loading from 1 - 2 mgs cm-2 which is the benchmarkto 3-4 mgs cm-2 while retaining the charge/discharge efficiency of the battery to above 95 %. Considering the large amount of sulfur in the proposed electrodes and the high volumetric expansion of sulfur during lithiation, fracture and collapse of the electrode upon cycling is inevitable. It is of critical importance for us to replace the conventional binder (PVDF) with a binder that could handle the stresses of lithiation/delithiation. We are keen to explore the possibility of replacing the conventional binder with graphene oxide.



[1] A. Akbari, P. Sheath, S. T. Martin, D. B. Shinde, M. Shaibani, P. C. Banerjee, R. Tkacz, D. Bhattacharyya, M. Majumder, Nature communications 2016, 7.

[2] M. Shaibani, A. Akbari, P. Sheath, C. D. Easton, P. C. Banerjee, K. Konstas, A. Fakhfouri, M. Barghamadi, M. M. Musameh, A. S. Best, M. R. Hill, A. F. Hollenkamp, M. Majumder, ACS nano 2016, 10, 7768.