

# Investigation of the role of electrolyte anions on $\text{Li}_2\text{S}$ electrodeposition chemistry for high-performance Li-S batteries.

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Lithium-Sulfur battery, based on its high energy density, places as one of the most promising candidates to replace current Li-ion batteries. However, during discharge of Li-S cell, an insulating final discharge product, lithium sulfide ( $\text{Li}_2\text{S}$ ) deposits on the electrode surface in a random manner. The uncontrolled lateral growth of  $\text{Li}_2\text{S}$  triggers high polarization and imposes a limitation in achieving high sulfur utilization.

Here we report that, by modulating the electron donating property of electrolyte salt anions, it is possible to induce 3D nucleation/growth of  $\text{Li}_2\text{S}$ . The morphological differences with changing the anion property are clearly demonstrated using ex-situ analysis as well as electrochemical measurements including chronoamperometric technique. The alteration in  $\text{Li}_2\text{S}$  deposition chemistry, as a result, leads to over 90% of sulfur utilization by preventing the early passivation of the active electrode surface. This finding offers a novel academic strategy for designing high-performance Li-S batteries, which exploits the critical role of anion in  $\text{Li}_2\text{S}$  nucleation and growth.

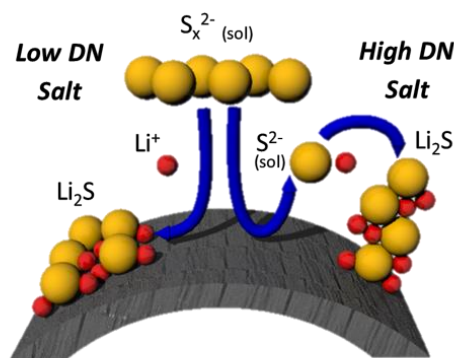


Figure 1 | Proposed mechanism for different  $\text{Li}_2\text{S}$  electrodeposition processes with modulating the donating property of electrolyte salt anions