Title: Porous MXene based sulfur hosts in Lithium Sulfur Batteries

Compact energy storage devices with eminent gravimetric and volumetric energy densities are imperative needs in the field of modern mobile electronic devices, unmanned aerial vehicles, and electric vehicles. Thanks to their high specific energy and cost-effectiveness, lithium-sulfur batteries (LSBs) are well-positioned to succeed the use of lithium-ion batteries. In fact, LSBs have been shown to offer specific energies in the order of 500 to 600 W h/kg – significantly better than the 150 to 250 W h/kg achieved by lithium-ion batteries. However, the sluggish reaction kinetics and severe shuttle effect of the sulfur cathodes hinder their practical applications. To address these issues, various conductive polar materials (heteroatoms- doped carbon, transition metal compounds, and polymers) with high affinity to lithium polysulfides (LiPS) have been introduced into the cathodes for not only to improve the electrical conductivity and accommodate the volume changes of the overall cathodes but also to restrain soluble LiPS in the cathodes thereby greatly improve the cycling performances

MXene is one type of emerging 2D layered material in the field of energy storage, which exhibits high conductivity, outstanding hydrophilicity, and excellent chemical/mechanical stability. Their surfaces are terminated with rich polar groups, such as −OH, O, and F, which could provide strong chemical interactions for LiPS trapping. Owing to these advantages, the main aim of this project is to design a 3D lightweight, flexible, conductive MXene scaffold with high mechanical strength capability with synchronously realizing high current density and large capacity for Li-S cathodes. All research within the components will be realized in the form of pouch cells produces at the Ford PERDC facility at Windsor.

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