I will start by giving an overview of active research activities in my research group located at University of Maryland Energy Research Center (UMERC). Then I will focus on three research topics.

In Topic One, I will discuss nanomanufacturing of different generations of transparent paper substrates with tailored optical and mechanical properties, followed by their applications in electronics, photonics and optoelectronics.

In Topic Two, I will discuss nanoscale interface engineering for low-cost Na-ion batteries toward Grid-scale energy storage. I will then extend similar interface engineering method in all solid-state Li metal batteries with Garnet electrolytes.

In Topic Three, I will display our pioneering research on Intercalation Optoelectronics, where the optoelectronic properties of two-dimensional materials (such as graphene, reduced graphene oxide and MoS$_2$) are tailored reversibly with metal ions.