Atomic substitution approach for non-vdW 2D materials

Xi Ling
Assistant Professor, Department of Chemistry
Division of Materials Science and Engineering
Boston University

Research site:
https://sites.bu.edu/xling/

Abstract

Atomically thin materials often exhibit extraordinary chemical, optical, electronic, and magnetic properties compared with their bulk 3D counterparts, enabling a variety of applications for next generation electronics and quantum information technologies. While extensive research has been conducted on 2D van der Waals (vdW) materials such as graphene, transition metal dichalcogenides (TMDs), and hexagonal boron nitride (hBN), little attention has been given to non-vdW materials, which make up the majority of materials in nature. One significant challenge is the lack of an effective synthesis method to access them. In this talk, I will introduce an atomic substitution approach that we have developed to convert vdW layered materials to ultrathin non-vdW materials. This approach is universal, enabling the synthesis of diverse unconventional 2D materials with tunable thicknesses, desired dimensions, and properties for fundamental physics investigations and nanodevices. As a model system, we will demonstrate the conversion of MoS_2 to MoN_x, investigate the conversion process and dynamics, and highlight the benefits of this approach in creating new 2D heterostructures as essential building blocks for 2D electronics.

References:

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