Playing in the Sandbox of chemistry and 2D materials

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Layered and two-dimensional (2D) materials encompass a wide research area spanning multiple filed. They are studies for their thin nature enabling applications in flexible devices as well as for their ease to be incorporated into highly tunable devices, as well as for their enhanced catalytic activity at the edges. In my lab, we try to synthesize both new 2D and layered materials, using chemical methods that are often underexplored in the field. My talk with such several different avenues:
A large portion of research in 2D materials is limited to mechanical exfoliation of van der Waals (vdW) materials. Chemical exfoliation is a relatively under-utilized route for preparing ultra-thin quantum materials, but it accesses 2D materials that cannot be obtained by mechanical "Scotch-taping."' It is also a way to mass produce 2D materials, as mechanical taping only accesses small amounts, insufficient for industrial applications. However, chemical exfoliation comes with the drawback that it commonly introduces many defects into the 2D sheets. In this talk I will show the challenges of using chemical exfoliation for 2D quantum materials synthesis, to then introduce systems in which the approach was successful.
One major reason for the popularity of 2D materials lies in the fact that their properties are often different from those of their layered bulk counterpart. A famous example is MoS2, which has an indirect bandgap in the bulk, but its monolayer has a direct one, making it feasible for many optical applications. In my lab we are exploring the possibility of using molecular intercalation to create bulk materials than mimic the properties of monolayers. I will report on our progress of using this technique to create a new topological insulator material.