Direct Synthesis of Two-Dimensional Metal Chalcogenides Through Molecular Preorganization

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Two-dimensional materials are of substantial interest, due to their unique fundamental characteristics (e.g., non-symmetric conductivity) and the possibility of large-scale processability. Recent progress in the synthesis of two-dimensional (2D) materials has embraced precursor-based methodologies, offering a transformative approach to material fabrication. Notably, the utilization of specific precursors plays a pivotal role in engineering tailored 2D materials. For instance, the controlled manipulation of two bismuth alkyl thiolates, $Bi(SR)_3$, differing only in alkyl substituents (-Bu^t versus -Pr^i), has demonstrated their efficacy as single-source precursors in the chemical vapor deposition (CVD) process. These precursors efficiently supply both Bi and S for the fabrication of targeted 2D structures without the need of any carrier gas or co-reactants.

Moreover, the direct synthesis of tin monoselenide (SnSe) and tin diselenide ($SnSe_2$) materials has been achieved through the thermolysis of molecular compounds utilizing a novel class of seleno-ligands. These advancements underscore the precision and versatility of precursor-driven techniques in harnessing the "power of synthesis" for controlling the layer thickness, crystal structure, and elemental composition, thereby enabling the development of diverse 2D materials. *This talk will address the chemically controlled synthesis of 2DMs and demonstrate their superior performance in electrocatalysis, and sensing applications.*

References

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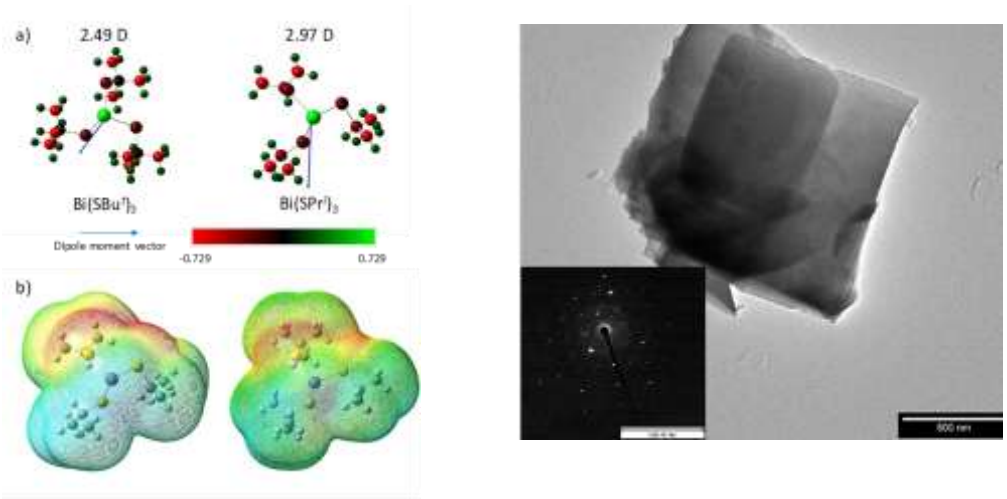

Figure 1. Molecular bismuth thiolates and TEM images of Bi2S3 produced by chemical vapor deposition.