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Large Area Synthesis of 2D Materials

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Transition metal dichalcogenides (TMDs) have generated significant interest for numerous applications including sensors, flexible electronics, heterostructures and optoelectronics due to their interesting, thickness-dependent properties. Despite recent progress, the synthesis of high-quality and highly uniform TMDs on a large scale is still a challenge. In this talk, synthesis routes for WSe2 and MoS2 that achieve monolayer thickness uniformity across large area substrates with electrical properties equivalent to geological crystals will be described. Controlled doping of 2D semiconductors is also critically required. However, methods established for conventional semiconductors, such as ion implantation, are not easily applicable to 2D materials because of their atomically thin structure. Redox-active molecular dopants will be demonstrated which provide large changes in carrier density and workfunction through the choice of dopant, treatment time, and the solution concentration. Finally, several applications of these large-area, uniform 2D materials will be described including heterostructures, biosensors and strain sensors.