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Growth, transfer, structural, optical, and electrical properties of large-size transition-metal dichalcogenide monolayer single-crystals[1]
ZHENG YANG, BO HSU, JIAO XIAO, GEORGE POULOS, Univ of Illinois - Chicago, YANG RESEARCH GROUP TEAM — We report growth, transfer process, as well as structural, optical, and electrical properties of large-size and high-quality two-dimensional transition-metal dichalcogenide MX2 (M=Mo, W; X=S, Se) single-crystalline triangular-shape nanosheets composed of one to a few monolayers. A vapor-trapping enhanced chemical vapor deposition approach was employed for the MX2 monlayer single crystal growth. The number of layers, crystallinity, and uniformity of the as-grown MX2 were characterized and confirmed by Raman and photoluminescence measurements. The MX2 monlayer single-crystal triangles show comparable size and uniformity to the state-of-the-art results reported as of now. The optical properties of the MX2 were studied based on the analysis of the photoluminescence results. The electrical properties including resistivity, mobility, carrier type and concentration, and contact resistance of the MX2 were characterized by both three-terminal field-effect transistor and Hall effect transport measurements. The Hall bar devices were fabricated by lithography and dry-etching of the as-grown single-crystalline MX2. The transfer process of the MX2 from growth substrate (SiO2-on-Si) to various substrates was successfully demonstrated.

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