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Valleytronics Made to Order: Layer-by-Layer Stacking of TMD Sheets with ~cm Dimensions

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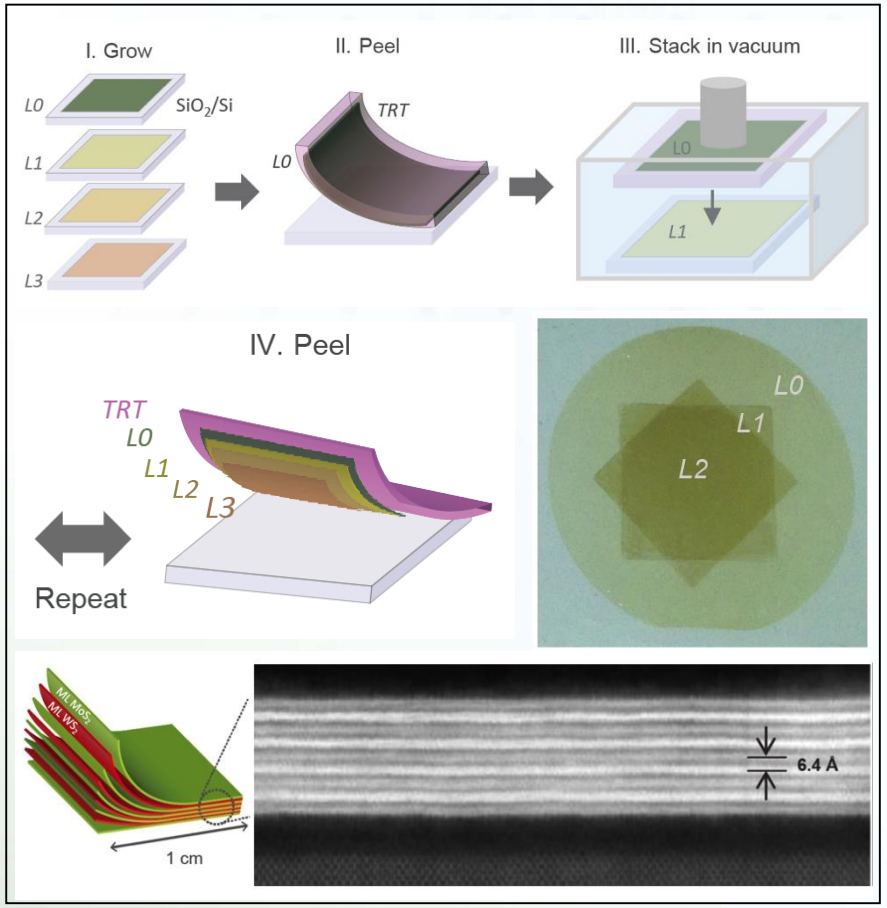
Building on their growing expertise with valleytronic materials, PARADIM researchers have discovered a way to assemble multi-layer stacks of monolayers of transition metal dichalcogenide (TMD) materials (MoS_2, $MoSe_2$, and WS_2) with centimeter-scale dimensions in a user-defined sequence. The assembly is achieved without the use of etchants or solvents by exploiting the stronger binding that occurs between TMD layers than between the TMD layer and the underlying substrate. Superlattices, bandgap engineered tunnel diodes, and tunnel device arrays with nearly ideal electrical properties have been demonstrated. Despite their large lateral extent, these made-to-order stacked structures show electrical properties that are not dominated by structural inhomogeneities that would strongly affect the tunnel current (e.g., cracks, wrinkles, or trapped impurities). This method enables TMDs to be combined in ways that are free of the constraints of lattice match or crystallographic alignment, enabling the layer-by-layer assembly of TMD-based device structures.



K. Kang et al., *Nature* **550** (2017) 229–233.

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