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Stretching Valleytronic Materials far beyond Conventional Limits to Tune their Properties

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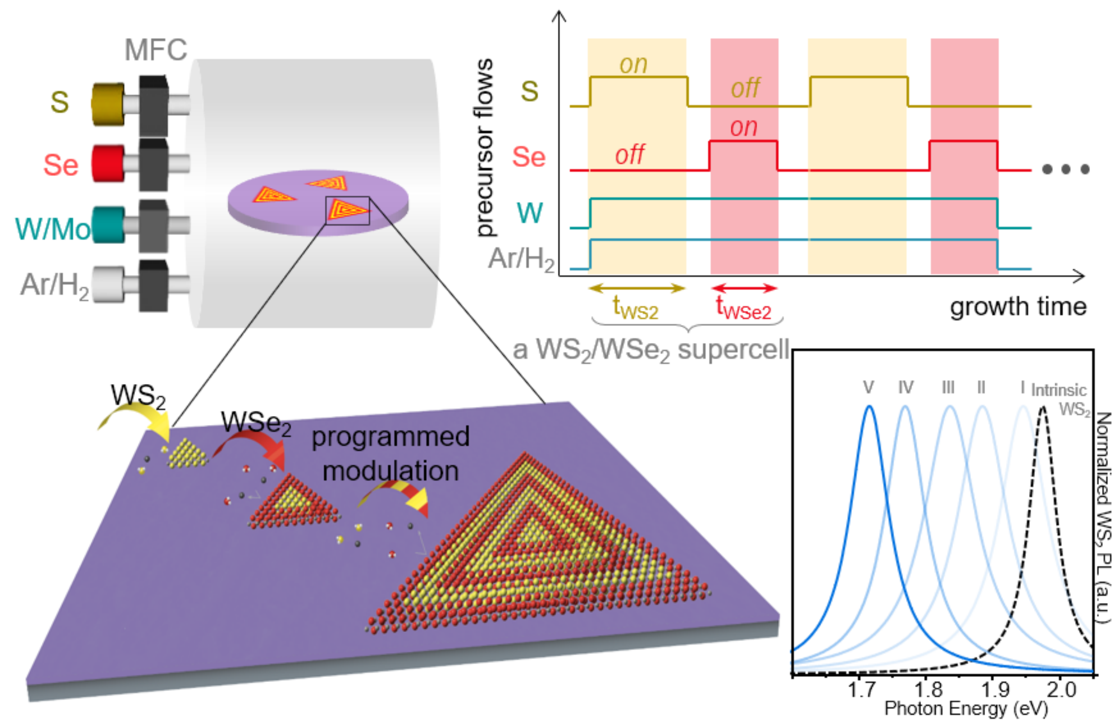
PARADIM researchers have created superlattice valleytronic materials—still just a single monolayer thick—by modulating the sequence in which the gas precursors are supplied during growth. The resulting two-dimensional (2D) superlattice single crystal differs from conventional superlattices of semiconductor materials in that it is connected in concentric rings. Such connection and the larger barrier to dislocation formation in 2D systems makes it possible to combine highly mismatched 2D materials and grow them to thicknesses far beyond conventional limits. Specifically, we demonstrate dislocation-free WS_2/WSe_2 superlattices that are more than 100×thicker than conventional semiconductor materials with comparable mismatch. At the large strains attainable the optical properties can be tuned dramatically; this approach should apply generally to 2D materials.

Despite the 4% mismatch in atomic spacing between WS_2 and WSe_2, when combined using wrap-around epitaxy the resulting monolayer is free of dislocations and exhibits *huge* shifts in bandgap



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