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Robotic Assembly of Quantum Fabrics from Atomically Thin Layers

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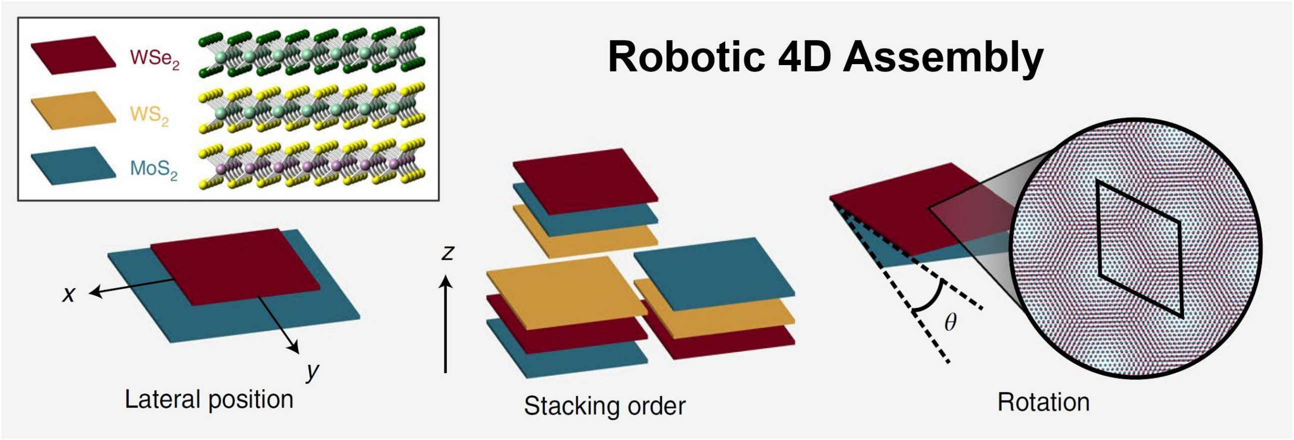
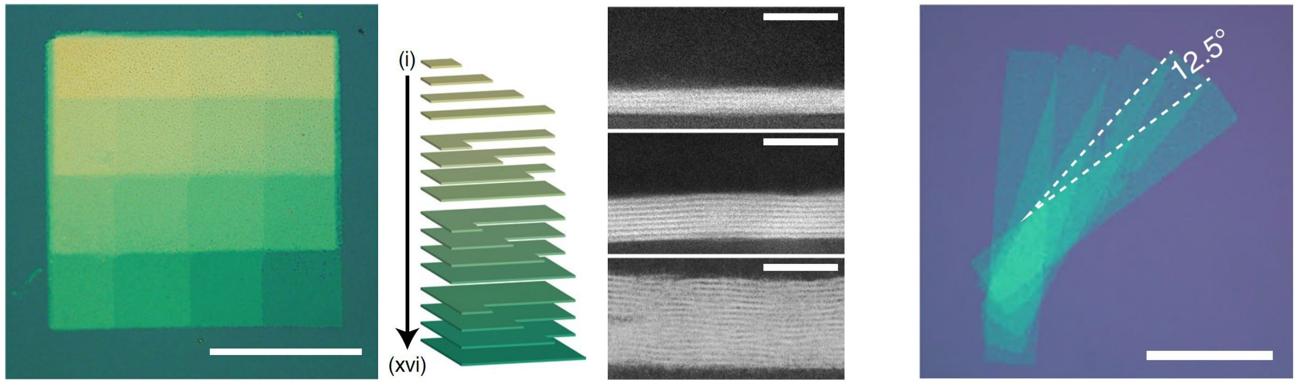
Quantum fabrics offer novel electronic, magnetic, or topological textures with functionalities that do not exist in bulk and could play an important role in future quantum technologies. Quantum fabrics are created by weaving together "threads" with different properties, such as superconductivity or magnetism. One method to make them is the atomically precise assembly of layered two-dimensional Van der Waals (vdW) materials. This assembly has traditionally been accomplished using artisan methods from micromechanical exfoliated flakes, but such fabrication is not compatible with scalable and rapid manufacturing.

Here, PARADIM's In-House Research group demonstrates a robotic assembly method for creating stacks of vdW layers with unprecedented speed, deliberate design, angle control, and large area. The building blocks are prepatterned "pixels" made from atomically thin two-dimensional components, like monolayers of transition metal dichalcogenide (TMD) materials (MoS_2, $MoSe_2$, and WS_2). The clean, contact-free process from growth, patterning, to assembly in vacuum is used to fabricate vdW solids containing up to 80 individual layers consisting of 100x100μm^2 areas with predesigned shapes, programmed composition, and controlled interlayer angle.

The PARADIM-developed method enables the rapid prototyping of quantum fabrics, which could help realize the full potential of vdW heterostructures as a platform for novel physics and advanced electronic technologies.





A.J. Mannix, *et al.*, available online *Nature Nanotechnology* (2022).