USC Viterbi School of Engineering
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Ming Hsieh Institute Seminar Series
Ming Hsieh Department of Electrical Engineering

Semiconductors & Microelectronics Technology

Automated assembly of synthetic van der Waals solids

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Date: Wednesday, March 1, 2023
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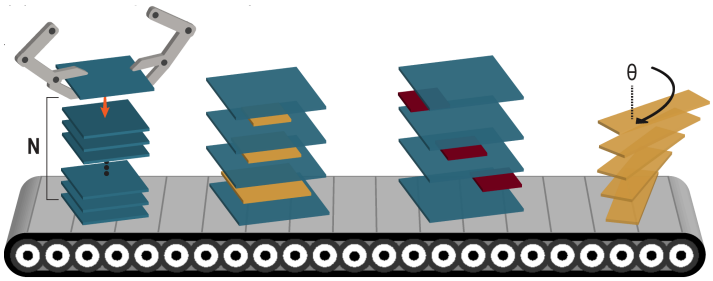
Abstract: Synthetic van der Waals (vdW) solids assembled from two-dimensional (2D) materials yield unprecedented, atomic-scale control over their structure and properties, with profound implications for future quantum, electronic, and photonic devices. Within these vdW solids, moiré superlattices arising from lattice mismatch and interlayer twist angle can host novel quantum states (e.g., superconductivity), emergent ferroelectricity, and tunable quantum confinement. However, the production of vdW solids remains a largely artisanal process, limited in the size of the source material and the fabrication throughput. In this talk, I will discuss our recent efforts to enhance the quality and speed of vdW solid fabrication. Our core approach, Robotic 4D Pixel Assembly, enables rapid manufacturing of designer vdW solids with unprecedented speed, area, patternability, and angle control. We utilize a high-vacuum robot to assemble prepatterned pixels made from 2D materials grown at the wafer scale. We fabricated vdW solids of up to 80 individual layers, consisting of (10 to 1000 μm)^2 areas with pre-designed patterned shapes, laterally/vertically programmed composition, and controlled interlayer angle. This enabled efficient optical spectroscopy assays of vdW solids and fabrication of twisted n-layer assemblies, where we observe atomic lattice relaxation of twisted 4-layer WS_2 at unexpectedly high interlayer twist angles of ≥4°. To conclude, I will outline ongoing efforts in my lab to understand and engineer high quality electronic interfaces, moiré superlattices, and point defects within vdW solids.



Biography: Andrew Mannix is an assistant professor of Materials Science and Engineering at Stanford University.

He completed his B.S. in Materials Science and Engineering at the University of Illinois at Urbana-Champaign, and his Ph.D. in Materials Science and Engineering at Northwestern University as an NSF GRFP Fellow, where he worked on the growth and atomic-scale characterization of new 2D materials. Before moving to Stanford, Andy was a Kadanoff-Rice Postdoctoral Fellow in the James Franck Institute at the University of Chicago, where he developed new methods of atomically-thin nanomaterials growth, processing, and automated heterostructure assembly. His lab at Stanford focuses on the growth, assembly and atomic-scale characterization of 2D materials for new electronic and quantum information science applications.

Hosted by Prof. Jianhua (Joshua) Yang, Prof. Han Wang, Prof. Chongwu Zhou, Prof. Stephen Cronin, and Prof. Wei Wu.
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