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Parallel Stitching of Two-Dimensional Materials XI LING, YUXUAN LIN, MILDRED DRESSELHAUS, TOMS PALACIOS, JING KONG, Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, DEPARTMENT OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE, MASSACHUSETTS INSTITUTE OF TECHNOLOGY TEAM — Large scale integration of atomically thin metals (e.g. graphene), semiconductors (e.g. transition metal dichalcogenides (TMDs)), and insulators (e.g. hexagonal boron nitride) is critical for constructing the building blocks for future nanoelectronics and nanophotonics. However, the construction of in-plane heterostructures, especially between two atomic layers with large lattice mismatch, could be extremely difficult due to the strict requirement of spatial precision and the lack of a selective etching method. Here, we developed a general synthesis methodology to achieve both vertical and in-plane "parallel stitched" heterostructures between a two-dimensional (2D) and TMD materials, which enables both multifunctional electronic/optoelectronic devices and their large scale integration. This is achieved via selective "sowing" of aromatic molecule seeds during the chemical vapor deposition growth. MoS_2 is used as a model system to form heterostructures with diverse other 2D materials. Direct and controllable synthesis of large-scale parallel stitched graphene-MoS_2 heterostructures was further investigated. Unique nanometer overlapped junctions were obtained at the parallel stitched interface, which are highly desirable both as metal-semiconductor contact and functional devices/systems, such as for use in logical integrated circuits (ICs) and broadband photodetectors.

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