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Chemical assembly of atomically thin transistors and circuits in a large scale MERVIN ZHAO, YU YE, Univ of California - Berkeley, YIMO HAN, Cornell University, YANG XIA, HANYU ZHU, YUAN WANG, Univ of California - Berkeley, DAVID MULLER, Cornell University, XIANG ZHANG, Univ of California - Berkeley — Next-generation electronics calls for new materials beyond silicon for increased functionality, performance, and scaling in integrated circuits. 2D gapless graphene and semiconducting TMDCs have emerged as promising electronic materials due to their atomic thickness, chemical stability and scalability. However, difficulties in the assembly of 2D electronic structures arise in the precise spatial control over the conducting and semiconducting crystals, typically relying on physically transferring them. Ultimately, this renders them unsuitable for an industrial scale and impedes the maturity of integrating atomic elements in modern electronics. Here, we report the large-scale spatially controlled synthesis of the single-layer MoS_2 laterally in electrical contact with graphene using a seeded growth method. TEM studies reveal that the single-layer MoS_2 nucleates at the edge of the graphene, creating a lateral van der Waals heterostructure. The graphene allows for electrical injection into MoS_2, creating 2D atomic transistors with high transconductance, on-off ratios, and mobility. In addition, we assemble 2D logic circuits, such as a heterostructure NMOS inverter with a high voltage gain, up to 70.

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