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Graphene-MoS2 Hybrid Technology for Large-Scale Two-Dimensional Electronics[1] LILI YU, HAN WANG, Massachussetts Institute of Technology, YI-HSIEN LEE, National Tsing-Hua University, XI LING, YONG-CHEOL SHIN, Massachussetts Institute of Technology, ELTON J.G. SANTOS, EFTHIMIOS KAXIRAS, Harvard University, JING KONG, TOMAS PALACIOS, Massachussetts Institute of Technology — Two-dimensional (2D) materials have generated great interest in the last few years as a new toolbox for electronics. This family of materials includes, among others, metallic graphene, semiconducting transition metal dichalcogenides (such as MoS_2) and insulating Boron Nitride. These materials and their heterostructures offer excellent mechanical flexibility, optical transparency and favorable transport properties for realizing electronic, sensing and optical systems on arbitrary surfaces. In this work, we develop several etch stop layer technologies that allow the fabrication of complex 2D devices and present for the first time the large scale integration of graphene with molybdenum disulfide (MoS_2), both grown using the fully scalable CVD technique. Transistor devices and logic circuits with MoS_2 channel and graphene as contacts and interconnects are constructed and show high performances. In addition, the graphene/MoS_2 heterojunction contact has been systematically compared with MoS_2-metal junctions experimentally and studied using density functional theory. The tunability of the graphene work function significantly improves the ohmic contact to MoS_2. These high-performance large-scale devices and circuits based on 2D heterostructure pave the way for practical flexible transparent electronics in the future.

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