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Controllable p-n Junction Formation in Monolayer Graphene Using Electrostatic Substrate Engineering HSIN-YING CHIU, VASILI PEREBEINOS, YU-MING LIN, PHAEDON AVOURIS, IBM Thomas J. Watson Research Center — The p-n junction is the basic element of modern electronics, providing the non-linear response essential for rectifying and switching currents. In conventional semiconductors, p-n junctions are produced by inserting donor and acceptor atoms in the crystal lattice. This approach, however, fails to produce effective results in nanoscale or low-dimensional electronic materials, such as graphene. Graphene itself is attracting much attention due to its unique electronic properties. In addition to having outstanding carrier mobilities graphene offers opportunities extending beyond CMOS technology, such as p-n junction electron (Veselago) lenses. Thus, graphene electronics depends on the ability to fabricate high-quality p-n junctions. Doping of graphene has been previously achieved by using multiple electrostatic gates, or charge transfer from adsorbants. Here we demonstrate a novel approach to create p-n junctions by changing the local electrostatic potential in the vicinity of one of the contacts without the use of extra gates. It is based on the electronic modification of the substrate and produces a well-behaved, sharp junction whose position and height can be controlled.

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