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High-quality epitaxial graphene devices with low carrier density for resistance metrology YANFEI YANG[1], LUNG-I HUANG[2], DAVID NEWELL, MARIANO REAL[3], RANDOLPH ELMQUIST, National Institute of Standards and Technology — Epitaxially grown graphene on silicon carbide (SiC) is a promising material for both quantum resistance metrology and wafer-scale electronics. However, monolayers are typically found to be heavily n-doped due to the charge exchange between the graphene and the non-conducting buffer layer beneath that is covalently bonded to the SiC substrate. Carrier densities are usually in the range of $10^{12} \sim 10^{13}$ cm^{-2}, where heavy doping shifts the quantized Hall resistance plateau to high magnetic field values. Various gating methods have been developed to reduce the carrier density, but require lithography processes that increase the probability of contamination that degrades the performance of the devices. Recently, we fabricated high-quality Hall devices on diced semi-insulating SiC wafers, obtaining carrier densities in the range of $10^{10} \sim 10^{11}$ cm^{-2} and mobility above 10^4 cm^{2}V^{-1}s^{-1} without gating. Graphene is grown on the Si face of SiC(0001) substrates and devices are fabricated using a metal layer subtractive process without organic chemical contamination of the graphene. We measure well-developed quantum Hall plateaus with filling factor $\nu = 2$, the fingerprint for monolayer graphene, at magnetic fields below 2 T at liquid helium temperature. A variety of quantum phenomena are observed in these clean, high quality graphene devices.

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