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Direct Imaging of Charged Impurities in Substrates used for Graphene Devices K.M. BURSON, Center for Nanophysics and Adv. Mat. (CNAM), U. of Maryland, College Park, C.R. DEAN, Dept. of Mech. Eng. and Dept. of Elec. Eng., Columbia U., New York, P. KIM, Dept. of Phys., Columbia U., New York, K. WATANABE, T. TANIGUCHI, Adv. Mat. Laboratory, Nat. Inst. for Materials Science, Tsukuba, Japan, S. ADAM, Center for Nanoscale Science and Tech., NIST, Gaithersburg, A.E. CURTIN, W.G. CULLEN, M.S. FUHRER, CNAM, U. of Maryland, College Park — The use of hexagonal boron nitride (h-BN) as a substrate for graphene led to approximately an order of magnitude improvement in electron mobility compared to graphene on SiO_2. One hypothesis for the improvement is a reduction in trapped charge density on the surface of h-BN compared to SiO_2. We address this directly by mapping local potential fluctuations above the bare substrates h-BN and SiO_2 using Kelvin probe microscopy in ultra-high vacuum. We compare the results to a model of randomly distributed charges in a 2D plane at the surface of an insulating substrate. For SiO_2, the results are well modeled by a 2D charge density of $\sim 2.5\text{x}10^{11}$ cm^{-2}. Previous measurements of charged impurity scattering in graphene indicates that this density of substrate charges would limit graphene mobility to 20,000 cm^2/Vs, in good agreement with the maximum values reported for graphene on SiO_2. h-BN displays potential fluctuations that are approximately an order of magnitude lower than SiO_2, consistent with an order of magnitude improvement in mobility in graphene/h-BN devices.
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