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Tuning Disorder and Interactions in Graphene[1]

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One (of many) unique aspects of graphene is that it is an atomically-thin two-dimensional electron system, open to manipulation and study using surface science techniques. This aspect of graphene has allowed us to tune both the disorder strength the interaction strength, allowing unprecedented control over a condensed matter system. Experiments are performed on atomically-clean graphene on SiO_2 in ultra-high vacuum. Addition of potassium to graphene is used to study the dependence of the mobility and minimum conductivity point on charged impurity density. Tuning the dielectric environment through addition of an ice overlayer has two effects: charged impurity scattering is reduced, due to reduced Coulomb interaction between impurities and carriers, while short-range scattering is increased, due to reduced screening. In sharp contrast to graphene with charged impurity disorder, which remains metallic at low temperature, even a small amount of irradiation-induced point disorder produces a divergence of the resistivity and insulating behavior at low temperature.

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