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Revealing the dominant scatterer in Graphene on SiO₂¹

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Freely suspended graphene sheets display high-field effect mobility, reaching 2×10^5 cm² /V s. Yet, suspended graphene sheets are fragile and impractical for most experiments and applications. Graphene sheets on SiO₂ are easier to handle but possess low-carrier mobilities, which can even vary by an order of magnitude from sample to sample. Poor and unpredictable transport properties reduce the utility of SiO₂-bound graphene sheets for both fundamental and applied sciences. Therefore, understanding the impact of substrates is crucial for graphene science and technology. We [1] have measured the impact of atomic hydrogen adsorption on the electronic transport properties of graphene sheets as a function of hydrogen coverage and initial, pre-hydrogenation field-effect mobility. The saturation coverages of atomic hydrogen for different devices are found to be proportional to their initial mobility, indicating that the number of native scatterers is proportional to the saturation coverage of hydrogen. By extrapolating this proportionality, we show that the field-effect mobility can reach 1.5×10^4 cm² /V s in the absence of the hydrogen-adsorbing sites. The affinity to atomic hydrogen is the signature of the most dominant type of native scatterers in graphene-based field-effect transistors on SiO₂. The dominant scatterer is identified by comparing the reactivity of charge puddles, ripples and resonant scatterers to atomic hydrogen.

[1] J. Katoch, J.H. Chen, R. Tsuchikawa, C. W. Smith, E.R. Mucciolo, and M. Ishigami, Uncovering the dominant scatterer in graphene sheets on SiO₂, Physical review B. Rapid Communications, 82, 081417 (2010).

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