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Direct Determination of the Absorption of Graphene Mono- and Multi-layers in the Visible and Near-Infrared YANG WU, KIN FAI MAK, CHUN HUNG LUI, JANINA MAULTZSCH, TONY HEINZ, Columbia University — Single-crystal mono- and multi-layer graphene samples were prepared by mechanical exfoliation on quartz substrates. The absorption spectra of samples of 1 – 8 monolayer thickness were measured in the optical and near-infrared range. The absorption coefficient was found to be largely independent of photon energy and linear in the number of graphene layers. Such absorption measurements can thus be used to determine the thickness of mesoscopic graphite to monolayer accuracy, as already demonstrated in the context of Rayleigh scattering [Casiraghi et al. Nano Letters 2007]. By analysis of the optical transmission problem for a thin film at the air-quartz interface, we deduced an absorption of 2.3% per layer. The magnitude of the monolayer absorption agrees with the value of $\pi\alpha$, where α is the fine-structure constant, and corresponds the result obtained from a tight-binding model of the graphene electronic structure [Gusynin et al. PRL 2006]. The predicted (and measured) optical absorption, we note, is equivalent to a constant optical conductance of$\frac{\pi e^2}{2h} = 6.09 \times 10^{-5}\Omega^{-1}$.

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