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Probing the Intrinsic Properties of Exfoliated Graphene: Raman Spectroscopy of Free-Standing Monolayers STEPHANE BERCIAUD, SUNMIN RYU, LOUIS BRUS, TONY HEINZ, Columbia University — The properties of pristine, free-standing graphene monolayers prepared by mechanical exfoliation of graphite are investigated. The graphene monolayers, which were suspended over open trenches, are examined by means of spatially resolved Raman spectroscopy of the G, D, and 2D phonon modes. The G-mode phonons exhibit low energies (1580 cm^{-1}) and broad widths (14 cm^{-1}) compared to the response for samples supported on the SiO_2–covered substrate. From analysis of the G-mode Raman spectra, we deduce that the free-standing graphene monolayers are essentially undoped, with an upper bound of $2\times10^{11}cm^{-2}$ for the residual carrier concentration. On the supported regions, significantly higher and spatially inhomogeneous doping is observed. The free-standing graphene monolayers show very little local disorder, based on the very low Raman D mode intensity.

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