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Raman Spectroscopy of the 2D Mode in Free-Standing Graphene Monolayers JANINA MAULTZSCH, T.U. Berlin, Germany, STEPHANE BERCIAUD, LOUIS BRUS, TONY HEINZ, Columbia U., New York, NY 10027 — Raman spectroscopy of the 2D (or G') mode is a critical tool for the analysis of graphene mono- and multilayers. This symmetry-allowed overtone mode permits one to probe zone-edge phonons by Raman spectroscopy. Moreover, its doubly-resonant electronic character[1] renders it readily observable and encodes in it information about the electronic structure of the graphene sample. In particular, the 2D mode provides a clear signature of the thickness of mono- and multilayer graphene films[2]. In this paper, we present a detailed study of the properties of the 2D for a pristine, free-standing graphene monolayer prepared by mechanical exfoliation over a trench structure. In contrast to the behavior of monolayers of graphene on substrates, for this pristine graphene sample, we observe a positively skewed line shape. The linewidth is also somewhat reduced compared to that observed for graphene supported on a substrate. Further, the 2D mode in the free-standing graphene films exhibits a slightly stronger dispersion with energy of the pump photons than for supported monolayers. We discuss our findings within the framework of double resonance theory, taking into account the intrinsically undoped nature of the free-standing graphene samples. [1]J. Maultzsch *et al.*, Phys. Rev. B **70**, 155403 (2004) [2]A. Ferrari *et al.* Phys. Rev. Lett. **97**, 187401 (2006)

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