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Long-wavelength optical phonon behavior in uniaxial strained graphene: Role of electron-phonon interaction

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We derive the frequency shifts and the broadening of Γ-point longitudinal optical (LO) and transverse optical (TO) phonon modes, due to electron-phonon interaction[1], in graphene under uniaxial strain[2] as a function of the electron density and the disorder amount. We show that, in the absence of a shear strain component, such interaction gives rise to a lifting of the degeneracy of the LO and TO modes which contributes to the splitting of the G Raman band. The anisotropy of the electronic spectrum, induced by the strain[2–4], results in a polarization dependence of the LO and TO modes. This dependence is in agreement with the experimental results showing a periodic modulation of the Raman intensity of the splitted G peak. Moreover, the anomalous behavior of the frequency shift reported in undeformed graphene is found to be robust under strain.

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