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Probing strain-induced changes of phonon dispersion in graphene by Raman spectroscopy HUGEN YAN, Departments of Physics and Electrical Engineering, Columbia University, MINGYUAN HUANG, JAMES HONE, Department of Mechanical Engineering, Columbia University, TONY HEINZ, Departments of Physics and Electrical Engineering, Columbia University — The Raman spectra of graphene include prominent features associated with two-phonon modes. This response is important because it permits us to probe the nature of phonons away from the zone center by optical spectroscopy. In graphene, these two-phonon processes are enhanced by electronic resonances and are associated with well-defined phonon momentum. In this paper, we examine the effect of the application of uniaxial stress on the doubly resonant intravalley scattering (2D') mode. The frequency and line-shape of the 2D' mode show a strong dependence on the angle between the incident light polarization and the stress axis. The response reveals the induced anisotropy of the phonon dispersion relation around the zone center, as well as the inherent light absorption anisotropy in k-space. As a result, the polarization dependence of the Raman response in strained graphene can be used to determine the principal axes of the strain. The phonon softens under tensile strain, exhibiting a softening rate similar to that of G mode.

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