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Temperature dependence of the anharmonic decay of optical phonons in carbon nanotubes and graphite IOANNIS CHATZAKIS, Columbia University, New York, NY 10027;Kansas State University,Manhattan,KS 66506, HUGEN YAN, DAOHUA SONG, STEPHANE BERCIAUD, TONY F. HEINZ, Columbia University, New York, NY 10027 — We report on the temperature dependence of the anharmonic decay rate of zone-center optical phonons in both single-walled carbon nanotubes and graphite from cryogenic temperatures to 650K. The measurements are performed using a pump-probe Raman scattering scheme with femtosecond (fs) laser pulses [Song et al. PRL 100,225503(2008)]. A nonequilibrium population of the zone-center (G-mode) optical phonons is created by an initial fs laser pulse. A subsequent fs probe pulse generates both Stokes and antiStokes Raman scattering, from which we infer the mode population of the G-mode phonons. We observe a large nonequilibrium phonon population in both systems, together with a room-temperature population lifetime of 1-2ps. The population decay is attributed to anharmonic coupling to lower-energy phonons [Bonini et al. PRL 99,176802(2007)]. We observe little T dependence of the decay rate below room temperature, but find a component growing roughly linearly with increasing T for >300K. We compare the behavior observed in nanotubes and graphite and discuss the implications of our results for the mechanism of the anharmonic decay of optical phonons in both systems.

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