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Escape time of an acoustic nanocavity mode

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We present a study of the escape time of a 1 THz nanocavity phonon mode as a function of the Q-factor of the cavity. We compare results from picosecond acoustics and high resolution Raman scattering experiments, the latter obtained by means of a Fabry-Perot/triple-additive spectrometer tandem. A nanocavity consists of a GaAs spacer enclosed by two acoustic GaAs/AlAs Bragg mirrors. The number of periods of the inner mirror varies from sample to sample, spanning a range $64 < Q < 2470$. This means that the cavity mode tunnels through the inner mirror to the substrate at theoretical time intervals that vary from 64 to 2470 ps for the different samples. An optic AlGaAs/AlAs Bragg mirror was grown between the substrate and the inner acoustic mirror in order to allow for the observation of the cavity mode in a backscattering configuration of the Raman experiments, otherwise forbidden by symmetry. At room temperature we observe escape times that vary from 65 to 278 ps. The theoretical values match the experimental results if a 3.0-GHz-wide lorentzian convolution is included to account for broadening effects. Possible explanations for this broadening will be discussed, as well as low temperature results.