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Title:Femtosecond ultrasonic spectroscopy using a piezoelectric nanolayer: Hypersound attenuation in vitreous silica films

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Abstract: We report ultra-broadband ultrasonic spectroscopy with an impedance-matched piezoelectric nanolayer, which enables optical generation and detection of a 730-fs acoustic pulse (the width of ten lattice constants). The bandwidth improvement facilitates THz laser ultrasonics to bridge the spectral gap between inelastic light and x-ray scatterings (0.1-1 THz) in the studies of lattice dynamics. As a demonstration, this method is applied to measure sound attenuation α in a vitreous SiO2 thin film. Our results extend the existing low-frequency data obtained by ultrasonic-based and light scattering methods and also show a α∝ f2 behavior for frequencies f up to 650 GHz.