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Hypersonic properties of polymer films and multi-layers JAMES SHARP, PAUL WALKER, ERIC YOUNG, University of Nottingham, VITALI GOUSSEV, Université du Maine, ANDREY AKIMOV, ANTHONY KENT, University of Nottingham — Picosecond acoustic measurements were performed on ultrathin films of polymers and thin film polymer multilayers supported on silicon (Si) substrates using a state of the art THz acoustic technique. In these experiments, a high power laser is used to excite picosecond duration strain pulses in an aluminium film evaporated on the reverse side of the Si substrate. These strain pulses then propagate through the substrate and interact with the polymer film/multi-layer. Vibrations in the film are detected optically using the same (pump-probe) beam which is passed through an optical delay line and reflected from the surface of the polymer film/multi-layer. Ultrathin films of polystyrene and a styrene-butadiene-styrene block copolymer were found to exhibit quantized closed-pipe organ like modes in the 0- 50 GHz regime that were attributed to vibrations of the entire polymer film. Thin film polystyrene/polyvinylpyrrolidone multilayer structures were found to display folded phonon dispersion curves that are characteristic of super-lattice structures. These structures have potential applications in GHz and THz optical switching and biosensing applications.

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