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Phononic Properties of Periodic 1D Multilayer Polymer Films
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The evolution of phonon dispersion relation with composition and periodicity in 1D periodic multilayer nanoscale polymer films is studied using high resolution Brillouin light scattering. An increase in complexity of the dispersion relation as the lattice constant d becomes comparable to the phonon wavelength (q^{-1}) is observed. Films with large d include phonons propagating within individual layers, as opposed to delocalized phonons moving throughout an effective homogeneous medium in films with small d. Temperature dependent measurements of the sound velocities reveal the presence of distinct glass transition temperatures in support of the distinct propagation of phonons through the periodic medium in agreement with theoretical predictions. The structure related elastic excitations are determined by the product of the layer thickness and the phonon wave vector qd and hence all layer guided modes are superimposed in a reduced plot of the phase velocity v vs qd.

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