Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Hypersonic hybridization band gaps in structures based on polymer-tethered colloids.[1] ELENA ALONSO-REDONDO, YU CANG, ANNA REUSS, Max Planck Institute for Polymer Research, REBECCA SAINIDOU, PASCAL REMBERT, 2Normandie Univ, UNIHAVRE, Laboratoire Ondes et Milieux Complexes, UMR CNRS , KRZYSZTOF MATYJASZEWSKI, Department of Chemistry, Carnegie Mellon University, MICHAEL BOCKSTALLER, Department of Materials Science and Engineering, Carnegie Mellon University, GEORGE FYTAS, Max Planck Institute for Polymer Research — Phononic hybridization gaps, originating from the anti-crossing between local resonant and propagating modes, are robust to structural disorder and occur at wavelengths much larger than the size of the resonant unit. Here, polymer-tethered colloidal particles (particle brush) were used to fabricate hybridization gap structures harnessing the anisotropic elasticity across their solid particle-polymer interface. Brillouin light spectroscopy was employed to record the dispersion diagram for longitudinal and transverse phonons as a function of grafting density and polymer length. Frequency band gap width and position decreased with polymer volume fraction at roughly constant grafting density but increased with decreasing grafting density at constant volume fraction. Modeling of the phononic band diagrams using the layered-multiple scattering formalism revealed the importance of the boundary conditions and differences of the polymer elastic moduli from their isotropic bulk values. These intriguing findings were discussed in terms of structural and particle brush topology effects and complemented by the elastic excitations of the individual particle brush systems. The results point to new opportunities to harness efficient self-assembly methods for the fabrication of phononic materials.

[1]ERC-694977

George Fytas
Max Planck Institute for Polymer Research

Date submitted: 11 Nov 2016 Electronic form version 1.4