Recent Applications of Brillouin Light Spectroscopy to the study of soft matter-based nanostructured phononics

Prof. George Fytas

[1] *Max Planck Institute for Polymer Research,*

Nanostructured materials based on well-established polymer and colloids hold promises for a wide range of applications. Their realization, however, relies on a good understanding of the thermomechanical properties (e.g., glass transition temperature, elasticity) of the nanomaterials, which could deviate from those of their bulk counterparts due to effects like an increased surface-area/volume ratio and spatial confinement. As a non-contact, non-destructive technique, Brillouin light spectroscopy (BLS) provides unique characterizations of the thermomechanical properties of nanostructured materials via the resolution of hypersonic phonons with sub-micrometer wavelengths. In this contribution, three recent applications of BLS will be highlighted. (i) Band structure of colloid-based phononics involving different band gap mechanisms. (ii) Glass dynamics and elasticity of nanoparticles utilizing particle vibration spectroscopy. (iii) Enhanced isotropic elasticity in polymer-tethered nanoparticle films and anisotropic thermoelasticity in hybrid Bragg stacks utilizing long phonon wavelengths outside the bandgap region. At the end, a novel observation of light absorption enhancement in transparent particle-brush opals with size-tunable photonic band gap through slow photons, in spite of the low refractive index contrast.