Determination of Nanoscale Mechanical Properties of Polymers via Plasmonic Nanoantennas

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Abstract

Nanotechnology and the consequent emergence of miniaturized devices are driving the need to improve our understanding of the mechanical properties of a myriad of materials. Here we focus on amorphous polymeric materials and introduce a new way to determine the nanoscale mechanical response of polymeric thin films in the GHz range, using ultrafast optical means. Coupling of the films to plasmonic nanoantennas excited at their vibrational eigenfrequencies allows the extraction of the values of the mechanical moduli as well as the estimation of the glass transition temperature via time-domain measurements, here demonstrated for PMMA films. This nanoscale method can be extended to the determination of mechanical and elastic properties of a wide range of spatially strongly confined materials.

KEYWORDS: nanomechanics, ultrafast optics, nanoantennas, polymers, plasmonics