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Local Optical Probe of Motion and Stress in a NEMS ANTOINE RESERBAT-PLANTEY, LAËTITIA MARTY, OLIVIER ARCIZET, NEDJMA BENDIAB, VINCENT BOUCHIAT, Institut Néel CNRS, DEP NANO TEAM —
Nanoelectromechanical systems (NEMSs) are emerging nanoscale elements at the crossroads between mechanics, optics and electronics, with significant potential for actuation and sensing applications. The reduction of dimensions compared to their micronic counterparts brings new effects including sensitivity to very low mass, resonant frequencies in the radiofrequency range, mechanical non-linearities and observation of quantum mechanical effects. An important issue of NEMS is the understanding of fundamental physical properties conditioning dissipation mechanisms, known to limit mechanical quality factors and to induce aging due to material degradation. There is a need for detection methods tailored for these systems which allow probing motion and stress at the nanometer scale. Here, we show a non-invasive local optical probe for the quantitative measurement of motion and stress within a multilayer graphene NEMS provided by a combination of Fizeau interferences, Raman spectroscopy and electrostatically actuated mirror. Interferometry provides a calibrated measurement of the motion, resulting from an actuation ranging from a quasi-static load up to the mechanical resonance while Raman spectroscopy allows a purely spectral detection of mechanical resonance at the nanoscale. Such spectroscopic detection reveals the coupling between a strained nano-resonator and the energy of an inelastically scattered photon, and thus offers a new approach for optomechanics.

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