Ultrafast photoacoustic assessment of mechanical properties in InAs nanowires

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Nanowires (NWs) have been at the forefront of research in nanoscience for over two decades because of the wide range of applications driven by their peculiar properties [1]. Among the latter, mechanical properties play a crucial role in view of any device development, but, despite the effort, a clear understanding is still lacking [2]. We report [3] on the ultrafast photoaoustics investigation of the mechanical properties of vertical Wurtzite InAs NW. The assessment of the NW oscillation period versus NW length allows to properly access the elastic dispersion relation and to shed light on the long-standing problem of InAs NW mechanical properties. Specifically, a benchmarked elastic matrix is provided. A novel mechanism, triggering the mechanical oscillations, is unveiled. The nanowire oscillations originate from an impulsive "hammer-like" excitation triggered in the substrate and propagating in a wave-like motion into the NW. This mechanism constitutes a new paradigm, being at variance with respect to direct excitation mechanisms, as commonly encountered in ultrafast experiments on a plethora of nanosystems. The present rationalization of the genesis of the mechanical oscillations impacts ultrafast opto-mechanical applications at large and will contribute designing them beyond a trial-and-error approach.

References

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