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In-Situ Mechanical Characterization of Wurtzite InAs Nanowires

2012

Abstract

High aspect ratio vertical InAs nanowires were mechanically characterized in a scanning electron microscope equipped with two micromanipulators. One, equipped with a calibrated atomic force microscope probe, was used for in-situ static bending of single nanowires along the <11–20> crystallographic direction. The other one was equipped with a tungsten tip for dynamic resonance excitation of the same nanowires. This setup enabled a direct comparison between the two techniques. The crystal structure was analyzed using transmission electron microscopy, and for InAs nanowires with a hexagonal wutzite crystal structure, the bending modulus value was found to BM=43.5 GPa. This value is significantly lower than previously reported for both cubic zinc blende InAs bulk crystals and InAs nanowires. Besides, due to their high resonance quality factor (Q>1200), the wurtzite InAs nanowires are shown to be a promising candidate for sub-femtogram mass detectors.