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Electromechanical Properties of GaN Nanowires CHANG-YONG NAM, PAPOT JAROENAPIBAL, DOUGLAS THAM, DAVID E. LUZZI, JOHN E. FISCHER, Dept. of Materials Science and Engr., University of Pennsylvania, STEPHANE EVOY, Dept. of Electrical and Computer Engr., University of Alberta — GaN, an important wide and direct bandgap semiconductor for optoelectronic devices, also possesses excellent thermal stability, chemical inertness, and a high piezoelectric constant, making it suitable for high temperature chemical sensors and transducers. While one-dimensional GaN nanowires have attracted extensive research recently for nano-scale optoelectronic devices, their high aspect ratio, straightness and smooth surfaces suggest potential in nanoelectromechanical system (NEMS) applications such as high sensitivity mass sensing. In spite of such importance, electromechanical properties of GaN nanowires have not been accessed so far. Here, we investigate Young's modulus E and resonance quality Q of GaN nanowires by *in-situ* detection of electromechanical resonances in a transmission electron microscope. For the largest nanowire diameter observed (84 nm), E is close to the theoretical value of bulk GaN ($\sim$300 GPa) and gradually decreases for smaller diameters. Also we find Q generally higher than that of conventionally micromachined nano-scale Si resonators despite the larger surface-to-volume ratio, implying significant advantage of GaN nanowires in NEMS applications. Most nanowires display two closely-spaced resonances, which we attribute to low-symmetry triangular cross-sections.

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