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Elastodynamics of GaN nanowires at microwave frequencies
COLM FLANNERY, Materials Reliability Division, National Institute of Standards and Technology, Boulder, CO, KRISTINE BERTNESS, Optoelectronics Division, National Institute of Standards and Technology, Boulder, CO, SUDOOK KIM, WARD JOHNSON, Materials Reliability Division, National Institute of Standards and Technology, Boulder, CO — Single-crystal III-nitride nanowires have been the subject of extensive research because of their potential usefulness in innovative electronic, optoelectronics, and sensing applications. They also have been recognized as having several characteristics, including a relatively high surface-to-volume ratio, that are attractive for nanoelectromechanical systems (NEMS) applications, such as mass sensing. In this report, we present Brillouin-light-scattering (BLS) measurements and theoretical modeling of thermally excited vibrational modes in free-standing GaN nanowires with hexagonal cross sections ($\sim$70 nm to $\sim$200 nm in diameter) grown from a substrate by catalyst-free molecular beam epitaxy to a length of $\sim$8 μm. A series of modes with frequencies between 8 GHz and 50 GHz are seen in the BLS spectra with axial wavelengths between 270 nm and 1600 nm. Modeling of the normal modes was performed under the approximations of infinite length and circular cross section. The lowest-frequency BLS peak is identified as the lowest-order flexural mode. Stronger higher-frequency modes include ones with greater phase variation around the circumference.

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