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Magnetoelastic Measurements in a (Ga,Mn)As Nanoelectromechanical Resonator SOTIRIOS MASMANIDIS, EDWARD MYERS, HONGXING TANG, MO LI, MICHAEL ROUKES, California Institute of Technology, KRISTIAAN DE GREVE, GEERT VERMEULEN, WIM VAN ROY, IMEC —
We have employed nanoelectromechanical systems (NEMS) to obtain the first experimental measurements of the magnetostriction constants of a dilute magnetic semiconductor. A NEMS resonator is patterned from (Ga,Mn)As, grown epitaxially with 5.2 percent Mn and Curie temperature of 57 K. The device has a frequency and quality factor of 16.5 MHz and 6,300, respectively. Transduction is carried out by the piezoresistive effect, and using a phase-locked loop to monitor frequency. Resonance frequency shifts due to magnetostrictive strain are observed upon magnetizing the device with an applied field. By fitting a phenomenological model of magnetoelastic stress, combined with the Stoner-Wohlfarth model of magnetization reversal to the angular dependence of the frequency tuning effect, the (Ga,Mn)As magnetostriction and anisotropy field constants are derived. The connection between magnetostriction and magnetic anisotropy is discussed, together with comparisons to theoretical predictions.

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