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***In-situ* Transduction of the In-Plane and Out-of-Plane Modes of Nanowire-based Very-High Frequency Electromechanical Resonators**

WAYNE FUNG, WEI LU, University of Michigan — Recent advances in nanoelectromechanical systems (NEMS) promise important applications such as mass and force sensing, rf signal generation and timing, and quantum measurement studies. Chemically synthesized nanowires appear especially attractive for NEMS because of their atomically smooth surfaces and large aspect ratios. Here we report the measurements of doubly-clamped beam mechanical resonators using SnO_2 nanowires with widths ranging from 30 to 80 nm. The devices are electrostatically actuated and detected on-chip using a dual-gate setup and an all-electronic transduction scheme. This setup also allows us to independently actuate and tune the resonant frequencies of both the in-plane and out-of-plane modes of vibration *in situ*, potentially leading to NEMS-based practical applications. Our devices exhibit resonant frequencies ranging from 30 to 100 MHz, quality factors up to 2000, force sensitivities down to 10^{-14} N/Hz$^{1/2}$, and mass sensitivities down to 5 x 10^{-17} g. The frequency of the in-plane and out-of-plane modes can be tuned within ± 1 MHz of their nominal values at gate voltages of ± 5 V.

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