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Graphene-Aluminum Nitride Nano Plate Resonators

Z. Qian[1], Y. Hui[1], F. Liu[2], S. Kar[2] and M. Rinaldi[1]

[1]Department of Electrical and Computer Engineering, Northeastern University, Boston, USA,
[2]Department of Physics, Northeastern University, Boston, USA

Abstract

The physical and electrical properties of the metal electrodes fundamentally limit performance and volume and frequency scaling of conventional Micro and Nano Electro Mechanical Systems (MEMS/NEMS) piezoelectric resonators. To address this fundamental issue, we propose an innovative device concept in which Graphene (the thinnest known material in the universe with high electrical conductivity and ultra-low loss) is employed as electrode material to excite a high frequency bulk acoustic mode of vibration in a metal-free piezoelectric Aluminum Nitride (AlN) nano-plate. The extraordinary chemical, physical and electrical properties of graphene enable the implementation of ultra-high performance piezoelectric NEMS resonators with unique application enabling features. Thanks to this technology platform, a new class of chemical sensors capable of tagging gas molecules with high throughput and unprecedented levels of sensitivity and selectivity will become reality. Furthermore, a new class of tunable NEMS resonant G-AlN metamaterials is envisioned with a revolutionary impact in multiple applications areas such as IR/THz sensing and RF communications.