Canadian Association of Physicists   Association canadienne des physiciens et physiciennes

Contribution ID: **1645**   Type: **CLOSED - Oral (Student, In Competition) / Orale (Étudiant(e), inscrit à la compétition)**

Nonlinear response of nano-electro-mechanical graphene resonators fabricated by chemical vapour deposition

Tuesday 30 May 2017 16:00 (15 minutes)

Graphene is an ideal material for high quality nano-electro-mechanical resonators due to its high Young's modulus, low mass to surface ratio, ability to sustain high in-plane strain, and unique electrical properties like high carrier mobility, ballistic transport and nonlinear modulation of conductance under the electric field effect. In this work, atmospheric pressure chemical vapour deposition is employed to obtain monolayer graphene on copper. Scanning electron microscopy, Raman analysis and two-terminal electrical measurements reveal the presence of high quality, predominantly monolayer graphene. The graphene is transferred to Si/SiO2 wafers and multiple step electron beam lithography, metal deposition, substrate etching and critical point drying are used to fabricate suspended graphene doubly-clamped resonators. The devices are electrostatically actuated and their motion is read out using nonlinear mixing of graphene's electrical conductivity (1). Modeling the devices as Duffing resonators (2) shows the presence of mechanical nonlinearity in response to an applied force even at moderate bias voltages. We discuss the implications of this nonlinearity for parametric amplification, mode-mixing and the generation and measurement of squeezed thermomechanical states (3). The models are compared with experimental data and prospects for developing measurement techniques for high precision sensors and quantum-limited mechanical measurements of graphene are explored.

1. Chen, C, et al. Nature nanotechnology 4.12 (2009): 861-867}.
2. Lifshitz, Ron, and M. C. Cross. Review of nonlinear dynamics and complexity 1 (2008): 1-52
3. Rugar, D., and P. Grütter. Physical Review Letters 67.6 (1991): 699

Authors: Mr CHAUDHURI, Arnab (PhD Student); Dr KNOBEL, Robert (Associate Professor)

Presenter: Mr CHAUDHURI, Arnab (PhD Student)

Session Classification: T4-1 Thin Films (DCMMP) | Couches minces (DPMCM)

Track Classification: Condensed Matter and Materials Physics / Physique de la matière condensée et matériaux (DCMMP-DPMCM)