**Suspended Nanoelectromechanical Resonators with High Quality CVD Graphene**

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**Abstract** Graphene, a single atomic layer of graphite, possesses remarkable mechanical properties such as high Young's modulus, high surface area, and low mass. It is an ideal candidate for electromechanical resonators with high quality factor (Q) (Q ~ 100000 at low temperature). Suspended graphene devices can be fabricated from CVD-grown graphene using electron beam lithography, metal deposition to build electrodes and substrate etching. In this work we report our progress towards growing high quality CVD graphene for fabricating nanomechanical resonators for both fundamental experiments and applications as sensors. Atmospheric pressure CVD is employed to grow graphene at high temperature in a controlled mixture of methane, hydrogen and argon gas. The effect of substrate pre-treatment, concentration of methane and hydrogen, reaction time and temperature are identified as the key factors in determining the size and quality of graphene domains. D-G band intensity ratio of Raman analysis has confirmed the growth of high quality pre-dominantly monolayer graphene domains (Figure 1). Graphene after being transferred on Si-$SiO_2$ wafers are subjected to multiple step electron beam lithography to fabricate suspended resonators (Figure 2). The suspended devices can be used to study electromechanical properties of graphene, its nonlinear mechanics and can be cooled down towards their mechanical quantum ground state. Modeling the resonator as a general duffing resonator reveals that tuning the driving and gate voltage introduces duffing non-linearity, which modulates the Q factor thus providing control over its mechanical properties. Duffing nonlinearities also allow investigating the effects of parametric amplification and quadrature squeezing, thus building towards ultra precise position measurement. All these studies provide an immediate application of these devices in ultra-sensitive mass and force detection.

**Figures**

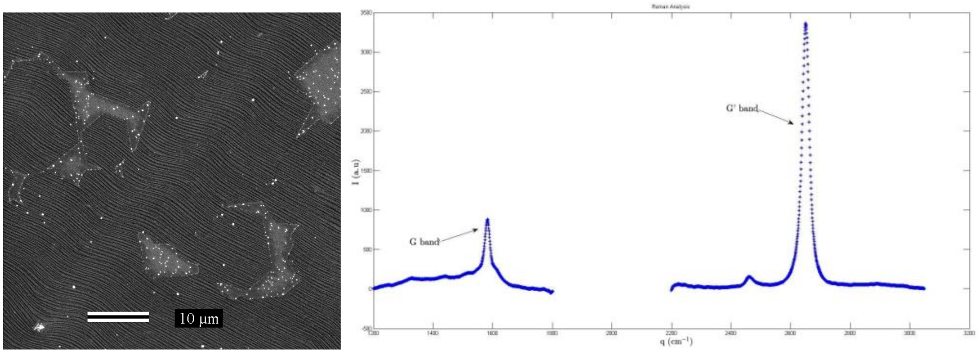


**Figure 1:** Monolayer graphene on Copper and Raman analysis to show high quality monolayer graphene.

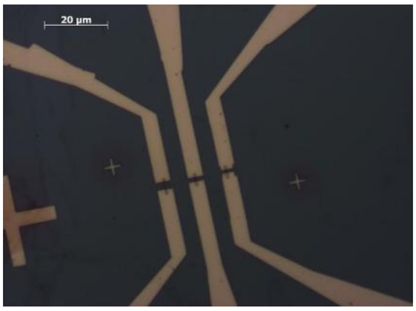


**Figure 2:** Suspended graphene resonators protected with HSQ in between gold electrodes.