Fabrication and of graphene nanomechanical resonators and defects and residual stress analysis through non-invasive characterization approach

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Graphene is the thinner material that exists in nature and it is one of the most studied material in the last decade. Thanks to its peculiar electrical and mechanical properties, graphene is one of the most implemented material for the fabrication of NEMS. Its shape, resistance and stability can be used to create innovative nanomechanical devices for ultralow mass and force detection as well as sensors for biological and chemical analysis.

For this purpose, we fabricate nanomechanical resonating devices based of suspended graphene layer, better known as Graphene Drums. The devices are fabricated with a standard wet approach based on the transfer of CVD grown graphene from the copper substrate to a patterned silicon wafer through an intermediate Poly(methyl methacrylate) PMMA layer. Vibrational performances of the graphene drums result strongly correlated to the presence of defects on the graphene layer or to residual stress due to the transfer process. We propose an approach based on multimode vibrational analysis to investigate the quality of the graphene resonators by looking at the frequency values of resonance peaks and the presence of peak splitting. With respect of optical, electron microscopy and electrical analysis this technique guarantees a fast and non-invasive approach to investigate the quality of suspended graphene drums over a large area.