A novel multilayer graphene growth mechanism: Nickel-catalyzed CVD process assisted by H_2 plasma

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Metal catalyzed CVD growth is a well established methodology for fabricating large area single- and few-layers graphene (respectively, on Cu and Ni) with high structural quality and transport properties. However, graphene implementation in devices needs its transferring from the metal foil onto the desired substrate with deterioration of material quality due to mechanical damaging, metal and polymer contaminations following the transferring process. Thus, significant efforts are currently being spent to explore new growth methodologies to obtain graphene directly on semiconductor and dielectric substrates [1].

We present a novel growth mechanism for the direct deposition of few layer graphene based on the nickel-catalyzed CVD process assisted by an H_2 plasma treatment. Graphene is grown at 900°C directly on the surface of the substrate of technological interest by carbon diffusion through nickel film by using methane (CH_4) as carbon precursors. Hydrogen atoms in the H_2-plasma downstream are used to promote the solubilization of carbon atom in Ni, thus, favouring the growth of graphene at Ni/substrate interface.
Structural and transport properties of the as grown multilayer graphene films on Si/SiO_2 and quartz substrates are provided. We demonstrate the peculiarity of this approach for controlling thickness and transport properties of as grown graphene film by process-step times.

References

[1] V.P. Pham, H. Jang, D. Whang, J. Choi, Chem. Soc. Rev., 2017, 46, 6276--6300.

Figures

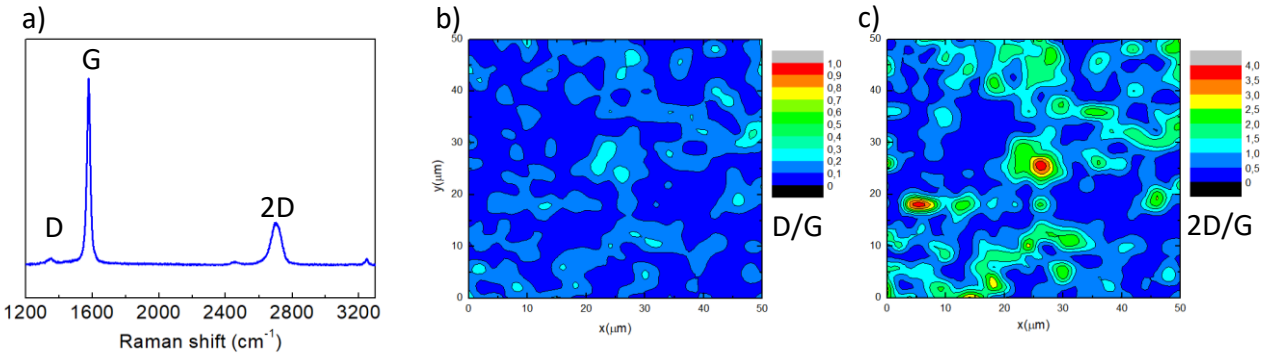

Figure 1: a) Typical Raman spectrum of few-layer graphene film grown on SiO_2/Si by nickel-catalyzed CVD process assisted by H_2 plasma; b,c) Raman maps (50*50μm^2) of D/G and 2D/G intensities ratio.