Graphene deposited on the top of a highly corrugated polymer substrate

L. Seremetis[*1], J. Parthenios[1], C. Galiotis[1,2] and K. Papagelis[1,2]

[1]*Institute of Chemical Engineering Sciences - Foundation of Research and Technology Hellas, 26504 Patras, Greece*
[2]*Materials Science Department, University of Patras, 26504, Greece*

Graphene and other materials, structures, and devices are increasingly influenced by surface forces as their size moves into the nm-range. This occurs because (i) the materials are often separated by small distances from the underlying substrate and are sensitive to the operant range of surface forces, (ii) the structural stiffness decreases as its size decreases, and (iii) both the surface forces and structural stiffness scale nonlinearly with relevant dimensions. For example, van der Waals energy between two molecules varies with separation, d, as $1/d^6$ over the range of ~1–10 nm and then transitions to $1/d^7$ for separations d > ~100 nm due to retardation effects, and the bending stiffness of a beam varies with thickness, t, as t^3[1].

Adhesion of graphene with neighboring materials and structures plays an important role in its behavior, both scientifically and technologically. Adhesive interactions are complicated due to the interplay between surface forces and topography.

In this work, the interaction of single graphene layers with the highly corrugated polydimethylsiloxane (PDMS) surface has been examined, by means of Raman spectroscopy and atomic force microscopy (AFM). Initially, AFM images show that the corrugation on PDMS is long-range with a wavelength of about 1.5μm and graphene is not fully conformed to the substrate. In fig.1a graphene shows rippling in between hills of the substrate. Using Raman spectroscopy and imaging, a correlation between topography and graphene conformation can be achieved. Particularly, by Raman mapping of high spatial resolution (~100nm step), it can be concluded that the redshift of either G or 2D Raman bands appear in locations corresponding to the corrugation hills (fig. 1b), where graphene is fully conformed. In locations where graphene partially conforms the redshift of the Raman bands is suppressed.

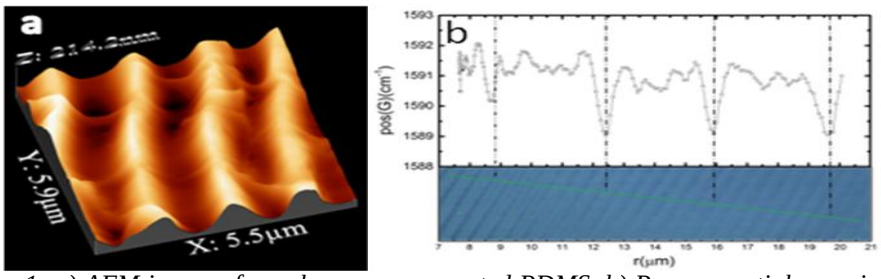

Figure 1: a) AFM image of graphene on corrugated PDMS, b) Raman spatial mapping along the designated line using 514.5nm excitation wavelength.

References

[1] J.S. Bunch, M.L. Dunn, Phys. Solids **152**, (2012) 1359–1364.

Acknowledgement

This research has been supported and financed by a GSRT project (ERC-10), entitled "Deformation, Yield and Failure of Graphene and Graphene-based Nanocomposites".

* lseremetis@iceht.forth.gr