CVD graphene on polymer substrate under tension

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Abstract

In general, CVD is suitable to apply highly dense and pure graphene based coatings such as pristine graphene on a substrate [1]. Skakalova et al. [2] have studied the growth mechanism of graphene sheets using the CVD method in order to fabricate high-quality large-area graphene sheet while a characterization regarding structure, electrical, optical and mechanical properties took place. As for the latter, plenty of work has been done over the last years [3-5] in order to investigate its behavior on external loading (tension and/or compression) in different substrates. In this work, Raman spectroscopy has been employed to monitor the deformation mechanics of monolayer CVD graphene on a poly(ethylene terephthalate) substrate (CVD graphene/PET) where the PET film is flat but the graphene is wrinkled The wrinkles have the effect of separating the graphene into isolated islands with size of about 1.5 μm, in which the wrinkle height is of the order of 15 nm (fig. 1a). Furthermore, it is found that upon deformation of the film, the shift of the Raman 2D band with strain for the graphene and the band broadening behavior is quite different from that of exfoliated monolayer graphene flakes (fig 1b). It is shown that the wrinkles have the effect of separating the graphene mechanically into isolated islands, with each island being similar in size to the Raman laser spot. It is demonstrated that inside each island the stress will be transferred non-uniformly from the PET (fig 1c) to the graphene and this allows the unusual Raman band shift and broadening behavior to be explained.

References

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Figures

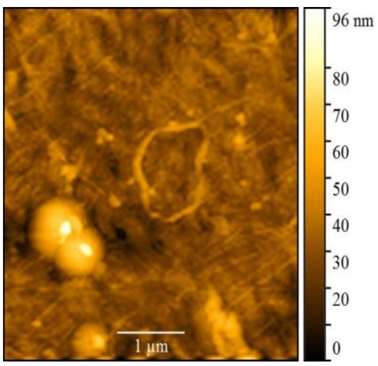

Fig. 1a: AFM image showing an isolated island formed by wrinkling. The height scale bar is in nm.

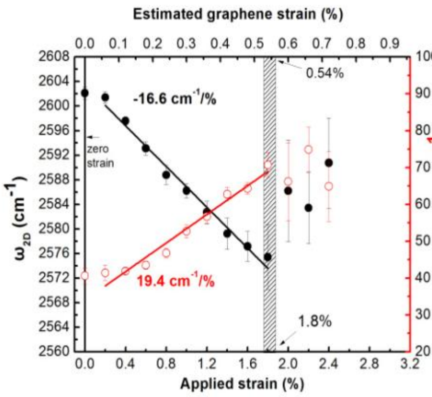

Fig. 1b: Pos(2D) and the corresponding FWHM(2D) as a function of the applied and the extracted actual strain for the graphene membrane on the PET substrate

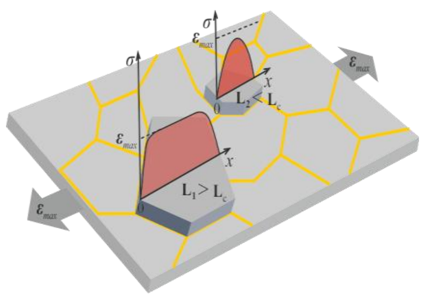

Fig.1c: Graph explaining the proposed stress transfer mechanism (L_i is the length of the *i*-crystallite and L_c the critical transfer length)