Stiffening graphene by controlled defect creation

Full Title

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Abstract

Graphene, due to its extremely high in plane stiffness and low bending rigidity, presents important out of plane thermal fluctuations crucial for the understanding of its mechanical properties.

In this work we measure the variation of the stiffness of graphene with induced vacancy density using AFM nanoindentations. Unlike predicted, we find that the stiffness of graphene increases with defect content until a vacancy density of 0.2 percent, where it doubles its initial value. For higher defect density the elastic modulus exhibits a decreasing tendency. We attribute the initial increase in stiffness to the quenching of the out of plane oscillations of graphene due to defects [1].

In order to validate this interpretation we also study the dependence of the elastic modulus with strain. We observe an increase of the Young's modulus at pre-strains higher than 0.5 percent where it again doubles its initial value.

References

[1] Lopez-Polin et al. Nature Physics accepted.