Bending Rigidity of Graphene Measurements by Electrostatic Actuation of Buckled Membranes.

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The small mass and atomic-scale thickness of graphene membranes make them highly suitable for nanoelectromechanical devices such as e.g. mass sensors, high frequency resonators or memory elements. Although only atomically thick, many of the mechanical properties of graphene membranes can be described by classical continuum mechanics. An important parameter for predicting the performance and linearity of graphene NEMS as well as for describing ripple formation and other properties such as electron scattering mechanisms is the bending rigidity, k. In spite of the importance of this parameter it has so far only been estimated indirectly for monolayer graphene from the phonon spectrum of graphite, estimated from AFM measurements or predicted from *ab initio* calculations or bond-order potential models. We employ a new approach to the experimental determination of k by exploiting the snap-through instability in pre-buckled graphene membranes [1]. We demonstrate the reproducible fabrication of convex buckled graphene membranes by controlling the thermal stress during the fabrication procedure and show the abrupt switching from convex to concave geometry that occurs when electrostatic pressure is applied via an underlying gate electrode. The bending rigidity of bilayer graphene membranes under ambient conditions was determined to be 35.5 ±0.2 eV. Monolayers have significantly lower k than bilayers.

References

[1] N. Lindahl et al., Nano Letters **12** **(**2012) 3526