Elastic Response of Graphene Nanodomes

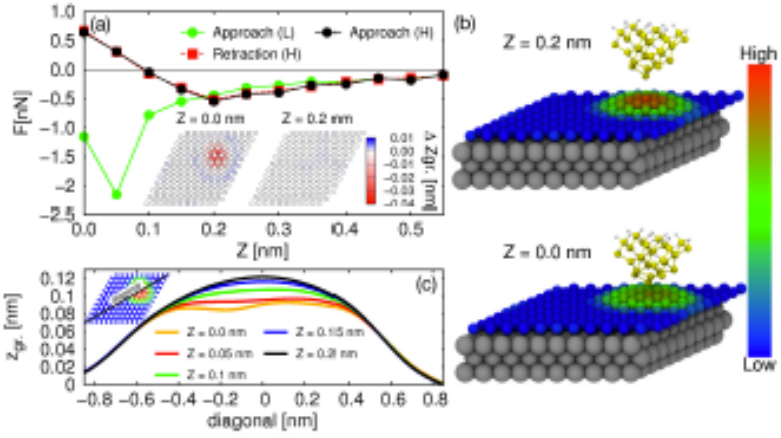
D. Stradi[1,2], S. Koch[3], E. Gnecco[2], S. Barja[2,4], A. Kawai[3], C. Díaz[1], M. Alcamí[1], F. Martín[1,2], A. L. Vázquez de Parga[4], R. Miranda[2,4], Th. Glatzel[3], E. Meyer[3]

[1]*Dept de Química, Univ. Autónoma de Madrid, 28049 Madrid, Spain*
[2]*Inst. Madrileñp de Estudios Avanzados en Nanociencia, Cantoblanco, 28049 Madrid, Spain*
[3]*Dept. of Physics, University of Basel, Klingelbergstr. 82, 4056 Basel, Switzerland*
[4]*Dept de Física de la Materia Condensada, Univ. Autónoma de Madrid, 28049 Madrid, Spain*
cristina.diaz@uam.es

Due to its exceptional properties graphene has become a topic of utmost importance [1-3]. One of the most remarkable features of a free standing graphene monolayer is its exception mechanical strength, which has allowed the development of electromechanical resonators [4,5].

In this study we have focused on the elastic properties of graphene adsorbed on a Ru(0001) surface. When graphene is grown on Ru(0001) a regular arrangement of nanodomes is spontaneously formed. Our experimental measurements [6] show that this periodic structure responds in a perfectly reversible way to perpendicular displacements up to 40% from the equilibrium structure. The elasticity of the nanodomes have been further proven by realistic DFT (density functional theory) calculations, we have estimated a normal stiffness k of about 40N/m [6].

In the figure we show the calculated force versus the distance for the hill site indentation, together with the optimized geometries of the force curve on the hill site of the nanodome (0.2 nm) and at maximum indentation (0.0 nm). The figure also shows the profiles of the indented graphene hill (Z≤0.2 nm) along the moiré unit cell diagonal (see inset Fig. c).



References:
[1] K. S. Novoselov et al, Nature Materials **306**, 666 (2004).
[2] A. Geim et al, Nat. Mater. **6**, 183 (2007).
[3] Y.-M. Lin et al, Science. **327**, 662 (2010)
[4] C. Lee **321**, 385 (2008)
[5] J. S. Bunch **315**, 490 (2007)
[6] S. Koch et al to be published