Extreme mechanics of graphene: from 2D to 3D structures

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Technological applications of graphene and other 2D-materials-based composites [1] require the understanding of their deformation mechanics also under extreme loads. Merging theory, atomistic and finite element (FEM) continuum simulations [2] we investigate the mechanics of these materials under tribological contact [3] and compressive/tensile load up to catastrophic crushing. The fundamental role of simulation in understanding the fracture and buckling phenomena which govern the constitutive behaviour of both 2D and recently proposed 3D structuring of graphene for enhanced energy absorption [4,5] will be addressed. Finally, the realization of multifunctional nanocomposites via large-scale biological factories, thus producing the so-called *bionicomposites* [6], will be also discussed.

References

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[4] A. Pedrielli, S. Taioli, G. Garberoglio, N. Pugno. *Carbon*. 111 (2017) 796-806.

[5] R. Meija, S. Signetti, A. Schuchardt, K. Meurisch, et al. *Nature Communications*. (2017), in press.

[6] L. Valentini, S. Bittolo Bon, S. Signetti, N. Pugno. *ACS Applied Materials & Interfaces*. 8 (2016) 7607-7612.

Figures

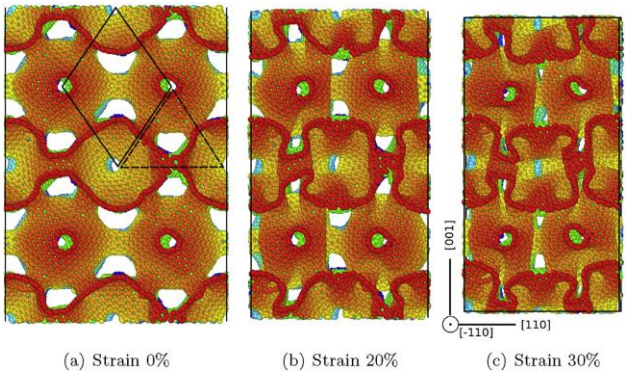

Figure 1: Molecular dynamic simulation of 3D graphene foam under compression [4].

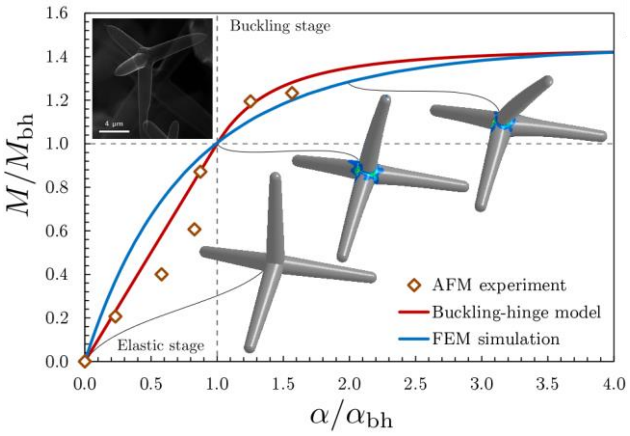

Figure 2: Bending behaviour of an Individual aerographite tetrapod forming a "buckling-hinge" at the central joint under large deflection of one of its arms [5].