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Nanomechanics of individual aerographite tetrapods

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Carbon-based three-dimensional aerographite networks, built from interconnected hollow tubular tetrapods of multilayer graphene, are ultra-lightweight materials recently discovered and ideal for advanced multifunctional applications. In order to predict the bulk mechanical behaviour of networks it is very important to understand the mechanics of their individual building blocks. Here we characterize the mechanical response of single aerographite tetrapods via *in situ* scanning electron and atomic force microscopy measurements. To understand the acquired results, which show that the overall behaviour of the tetrapod is governed by the buckling of the central joint, a mechanical nonlinear model was developed, introducing the concept of the buckling hinge. Finite element method simulations elucidate the governing buckling phenomena. The results are then generalized for tetrapods of different size-scales and shapes. These basic findings will permit better understanding of the mechanical response of the related networks and the design of similar aerogels based on graphene and other two-dimensional materials.

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