Mechanics model of multilayer graphene platelet films

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Abstract

Monolayer perfect graphene sheet has well been recognised for its superior mechanical properties [1]. However, it is very difficult to manufacture large size perfect graphene sheets due to unavoidable imperfections, e.g. additional layers, wrinkles, or folds [2]. In practical applications, graphene materials appear more frequently in the form of multilayer graphene platelet films (MGPFs) because the fabrication of MGPFs is comparatively more attainable, and moreover, MGPFs could have mechanical properties comparable to those of single layer perfect graphene sheet [3-5]. To optimise the design and maximise the mechanical properties of MGPFs, realistic 3D periodic multilayer random irregular representative volume element models are constructed, with each layer being a 2D periodic random Voronoi polygon structure [6,7] and each polygon representing a graphene platelet. The individual graphene platelets in a MGPF are held together by van der Waals interaction forces between the staggered graphene platelets. We use the commercial finite element software ABAQUS to simulate the mechanical properties of MGPFs. The graphene platelets are represented by shell elements and the van der Waals interactions are modelled a layer of solid elements with the equivalent isotropic elastic properties. The effects of the different geometrical parameters on the mechanical properties of MGPFs are investigated, and the normalised/dimensionless mechanical properties of MGPFs are obtained and compared with those of the relevant experimental measurements and computational simulations in literature. The results obtained can help enhance the mechanical properties of MGPFs and also apply to other materials such as nacre and seashells.

Key words: *Multilayer graphene platelet films; Elastic properties; Finite element simulation.*

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