Graphene as a prototype crystalline membrane: Structural, thermal and mechanical properties

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Graphene provides a model system for the development of a microscopic description of membranes. In the same way that geneticists have used Drosophila as a gateway to probe more complex questions, theoretical chemists and physicists can use graphene as a simple model membrane to study both phenomenological theories and experiments. I review key results in atomistic simulations of structural and thermal properties of graphene and compare them with the predictions of phenomenological theories. Both approaches lead to the conclusion that conventional Föppl – von Karman elastic theory of membranes is insufficient to describe mechanical properties of graphene, due to a crucial role of thermal fluctuations. I also consider graphene at very high temperature and compare the results with existing models for two-dimensional melting. The melting of graphene presents a different scenario, and we describe that process as the decomposition of the graphene layer into entangled carbon chains. Structure of graphene at hBN substrate is also briefly reviewed.

Figures

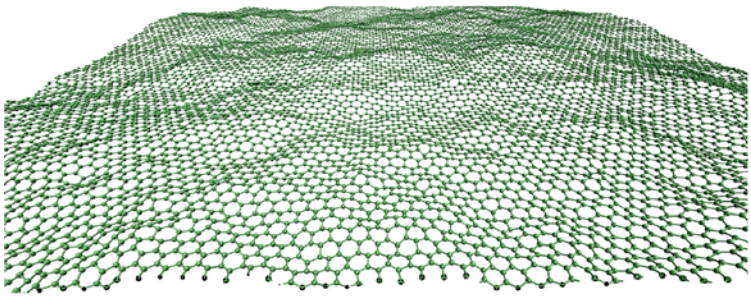

Figure 1: Graphene at room temperature; a snapshop from atomistic simulations