# Graphene Membrane Thin Films and Thermomechanical Ripples

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It is well known that ripples are a typical feature of graphene sheets and thin films comprised of graphene membranes [1,2]. They are produced by long wavelength corrugations and may greatly affect electronic properties of graphene-based systems and devices.

Several mechanisms of inducing such ripples in graphene have already been discussed in the literature. Among them is electron-induced rippling in graphene [3], as well as elasticity-induced rippling [4], that may, in the general case, include nonlinear effects. The origin of graphene rippling continues to be debated. In the meantime, there is substantial experimental evidence that in order to control such ripples, a pure eleasticity-based picture may not be sufficient [5] and thermal properties of graphene may also be essential.

In this contribution, we illustrate how to develop and apply a fully coupled model that describes thermomechanical processes in graphene sheets. Based on this model, we demonstrate that coupling between mechanical and thermal fields is an important factor in better understanding of the appearance of ripples in graphene. Next, we use a generalization of our multiband model [6] to analyze the effects of such thermomechanically-induced ripples on the electronic properties of graphene. Results of computational experiments are shown for different boundary conditions that allow controlling ripples.

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