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Entropy driven mechanics of surfaces and interfaces

Fatemeh Ahmadpoor[1]

[1] New Jersey Institute of Technology, United States. fatemeh.ahmadpoor@njit.edu

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Abstract

Flexible nanostructures such as graphene, molybdenum disulphide, phosphorene, boron nitride and MXenes, among many others are fascinating for their geometrical and mechanical characteristics and have opened tantalizing new applications such as nanosensors, biomedical devices, gene therapy, electronics, energy harvesting, structural composites, among others. One unique aspect of these nanostructures is that they constantly experience random deformations due to the thermal energy. These deformations impact their overall mechanical behavior and response to external stimuli. Thermal fluctuations also exist in biological membranes and are important for regulating many biological activities such as cell-cell communication, signaling, tracking and interactions with drug carrier nanostructures, yet are not easily incorporated in conventional mechanical models of crystalline and biological membranes. In this talk, I will present some of our recent efforts to integrate the continuum mechanics models of plates and shells with concepts of statistical physics. This integration enables us to understand and quantify the role of thermal fluctuations on the mechanical behavior of both biological and crystalline membranes and opens new routes for nondestructive experimental methods for studying the mechanics of these nanostructures.

Keywords:

Nanostructures Crystalline membranes Thermal fluctuations