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Membrane fluctuations alter the fluidity of clathrin protein lattices[1]

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Clathrin is a protein that plays a major role in the creation of membrane-bound transport vesicles in cells. The pinwheel subunits of clathrin assemble into closed, nanoscale assemblies with various shapes and sizes. We develop a model for clathrin, facilitating the study of membrane, surface, and bulk assembly. The clathrin are modeled as pinwheels that form leg-leg associations and resist bending and stretching deformations. Invoking theories of dislocation-mediated melting in two dimensions, we discuss the phase behavior for clathrin. We demonstrate that the generation of defects resembles creation of two dislocations, and we use orientational- and translational-order correlation functions to predict the crystalline-hexatic and hexatic-liquid phase transitions. Accounting for membrane fluctuations, we address the phase behavior of clathrin on a membrane surface. Membrane fluctuations act to soften the elastic coupling between defects in the clathrin lattice, altering the conditions for the crystalline-hexatic phase transition. This effect offers a mechanism for altering the fluidity of protein or polymer films. Furthermore, these results illustrate the pivotal role that molecular elasticity plays in the physical behavior of self-assembling and self-healing materials.

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