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Thermal mirror buckling transitions in a pristine freestanding graphene membrane investigated by scanning tunneling microscopy KEVIN SCHOELZ, University of Arkansas, VINCENT MEUNIER, Rensselaer Polytechnic Institute, PRADEEP KUMAR, University of Arkansas, MEHDHI NEEK-AMAL, Universiteit Antwerpen, PAUL THIBADO, University of Arkansas, FRANCOIS PEETERS, Universiteit Antwerpen — Freestanding graphene membranes are not flat, but rather display an array of ripples with alternating curvature. By applying a local force using a scanning tunneling microscope tip, we can pull out these ripples, causing the graphene membrane to reversibly rise and fall. By increasing the tunneling current and exploiting the negative coefficient of thermal expansion, we can increase the strain in the graphene membrane causing an irreversible transition from this flexible state to a rigid configuration. This transition typically happens when the graphene membrane reaches 60-70% of the total graphene height. We successfully model this transition as the transition of a spin-half Ising magnet where the ripples are modeled as Ising spins. The buckling transition can be interpreted as the transition from an antiferromagnetic state, to a ferromagnetic state. In addition, four critical exponents are measured. These results provide insight into the role of the negative thermal expansion of graphene.

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