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Incommensurate phases of a supported nanoparticle film subjected to uniaxial compression[1] SIHENG YOU, University of Chicago, BRAN LEAHY, Cornell University, MINKE ZHANG, YENCHAO CHUA, KA YEE C. LEE, University of Chicago, SUSAN N. COPPERSMITH[2], University of Wisconsin, Madison, BINHUA LIN, University of Chicago — We investigate experimentally and theoretically the sequence of phases that occurs when a self-assembled monolayer of gold nanoparticles supported on a fluid is compressed uniaxially in a Langmuir trough. Uniaxial compression of the monolayer results in the appearance of lines that have been shown to be regions of trilayer. These lines exhibit complex patterns that depend on the extent of compression. We show that these patterns can be understood in terms of an equilibrium statistical mechanical theory, originally developed in the context of commensurate–incommensurate transitions in krypton monolayers adsorbed on graphite, in which there is an energy cost to line deformations and to line intersections. Even though line intersections are energetically costly, they lower the free energy because they cause the entropy of the system to increase when the density of lines is low enough. Our analytic and Monte Carlo analyses of the model demonstrate that the model exhibits two-phase coexistence. Our experimental observations are qualitatively consistent with the predictions of the model.

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