Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Defect mechanics in crystalline packings of spherical caps[1] AMIR AZADI, Department of Physics, University of Massachusetts, Amherst, GREGORY M. GRASON, Department of Polymer Science and Engineering, University of Massachusetts, Amherst — Topological defects are ubiquitous in 2D curved crystals. We study the structural features and underlying principals of dislocation mechanics in a crystalline spherical cap. Using nonlinear elasticity, we show that frustration arising from the curvature drives the stability of finite length radial grain boundaries in the ground-state packing. For sufficiently large caps at intermediate Gaussian curvature, linear arrays of dislocations relieve the geometric stresses. The number and length of grain boundaries grows with both the curvature and the size of crystalline patch. We also determine the elastic response of the system subject to radial tension. The interplay between the geometrically induced stresses and the tension leads to inhomogeneous stresses that determines the stability of the grain boundaries. The imposed tension stretching the curved crystal radially destabilizes the curvature-induced compressive zone and decrease the length of the grain boundaries. We characterize the transition from a polycrystalline structure to the perfect packing where all dislocations will be expelled at a critical tension that depends on the system size and the curvature. We find scaling laws for the number and length of minimal configurations of grain boundaries.

[1]NSF CAREER DMR-0955760

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Date submitted: 17 Dec 2012

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