Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Capping spheres with scarry crystals: Organizing principles of multi-dislocation, ground-state patterns AMIR AZADI, Department of Physics, University of Massachusetts, Amherst, GREGORY M. GRASON, Department of Polymer Science and Engineering, University of Massachusetts, Amherst — Predicting the ground state ordering of curved crystals remains an unsolved, century-old challenge, beginning with the classic Thomson problem to more recent studies of particle-coated droplets. We study the structural features and underlying principles of multi-dislocation ground states of a crystalline cap adhered to a spherical substrate. In the continuum limit, vanishing lattice spacing, $a \to 0$, dislocations proliferate and we show that ground states approach a characteristic sequence of patterns of n-fold radial grain boundary "scars," extending from the boundary and terminating in the bulk. A combination of numerical and asymptotic analysis reveals that energetic hierarchy gives rise to a structural hierarchy, whereby the number of dislocation and scars diverge as $a \to 0$ while the scar length and number of dislocations per scar become remarkably independent of lattice spacing. We show the that structural hierarchy remains intact when n-fold symmetry becomes unstable to polydispersed forked-scar morphologies. We expect this analysis to resolve previously open questions about the optimal symmetries of dislocation patterns in Thomson-like problems, both with and without excess 5-fold defects.

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Date submitted: 14 Nov 2013 Electronic form version 1.4