Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Linking Mechanics and Statistics in Epidermal Tissues SANGWOO KIM, SASCHA HILGENFELDT, Univ of Illinois - Urbana — Disordered cellular structures, such as foams, polycrystals, or living tissues, can be characterized by quantitative measurements of domain size and topology. In recent work, we showed that correlations between size and topology in 2D systems are sensitive to the shape (eccentricity) of the individual domains: From a local model of neighbor relations, we derived an analytical justification for the famous empirical Lewis law, confirming the theory with experimental data from cucumber epidermal tissue. Here, we go beyond this purely geometrical model and identify mechanical properties of the tissue as the root cause for the domain eccentricity and thus the statistics of tissue structure. The simple model approach is based on the minimization of an interfacial energy functional. Simulations with Surface Evolver show that the domain statistics depend on a single mechanical parameter, while parameter fluctuations from cell to cell play an important role in simultaneously explaining the shape distribution of cells. The simulations are in excellent agreement with experiments and analytical theory, and establish a general link between the mechanical properties of a tissue and its structure. The model is relevant to diagnostic applications in a variety of animal and plant tissues.

Sangwoo Kim
Univ of Illinois - Urbana

Date submitted: 14 Nov 2014 Electronic form version 1.4