Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Complex Morphogenesis from Elastic Instability of Thin Sheets

PASCAL DAMMAN, Universite de Mons — Thin sheets are mechanically unstable to boundary or substrate-induced compressive loads. Moderate compression results in regular wrinkling while further confinement can lead to crumpling. In this communication, we will first show the emergence of a new morphological instability triggered by a period-doubling bifurcation observed for large compression ratio. A periodic self-organized focalization of the deformation energy is observed provided a symmetry breaking, induced by the elastic foundation, occurs. This effect will be explained by considering geometrical nonlinearities leading to a Euler-Lagrange equation similar to the equation of a parametric resonance in nonlinear oscillator. In the second part, we will show that thin sheets, from suspended graphene to ordinary hanging curtains, under boundary confinement spontaneously generate a universal self-similar cascade of wrinkled patterns. We develop a formalism based on *wrinklons*, a localized transition zone in the merging of two wrinkles, as building-blocks to describe the cascade morphology. These physical models based on elasticity and geometry constitutes a new theoretical toolkit to understand the morphology of various confined systems, such as coated materials or living tissues. Moreover, it also opens the way to new kind of microfabrication design of multiperiodic or chaotic (aperiodic) surface topography via self-organization.

Pascal Damman
Universite de Mons

Date submitted: 17 Nov 2010 Electronic form version 1.4