Solid-state wetting and dewetting

O. Pierre-Louis

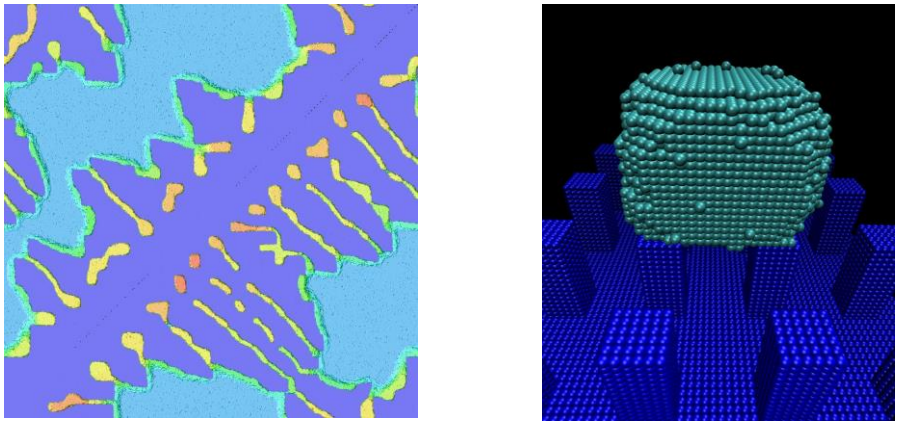
Institut Lumière Matière, UMR5306 Université Lyon 1-CNRS, Université de Lyon 69622 Villeurbanne, France

ABSTRACT

At the nanoscale, the morphological evolution of solid films and islands under annealing is strongly influenced by wetting properties. Inspired by analogies with recent advances in the wetting behavior of liquids, we explore two situations where solid-state wetting plays a crucial role.

In a first part, we discuss the dewetting dynamics of a thin solid film. During the dewetting a rim forms at the edge of the film where mass is accumulated. We focus on the dynamics and on the instabilities of the dewetting rim. We present some results based on 2D Kinetic Monte Carlo (KMC) simulations and analytical models, and their comparison to experiments.

In a second part, we will present the wetting statics and dynamics of islands (or nanoparticles) on surface topographical structures with a large aspect ratio, such as pillars or trenches. We show that solids can exhibit the so-called lotus effect –known for liquid drops on patterned substrates, where the particle floats on the top of the nano-structure. In addition, elasticity induces novel states for solid-state wetting, such as asymmetric and partially impaled configurations.



KMC Simulations-- Left: Dewetting of a thin solid film; Right: Cassie-Baxter state for a nanoparticle

REFERENCES

1. M. Ignacio, Y. Saito, P. Smereka, O. Pierre-Louis, Phys Rev Lett 12 146102 (2014)
2. A. Chame O. Pierre-Louis, Phys Rev B (2014)
3. M. Ignacio, O. Pierre-Louis, Phys Rev B 86 235410 (2012)
4. A. Chame, O. Pierre-Louis, Phys Rev E 85 011602 (2012)
5. M. Dufay, O. Pierre-Louis, Phys Rev Lett 106 105506 (2011)
6. P. Gaillard, Y. Saito, O. Pierre-Louis, Phys Rev Lett 106 195501 (2011)
7. K. Takano, Y. Saito, O. Pierre-Louis, Phys Rev B 82 075410 (2011)
8. E. Bussmann, F. Cheynis, F. Leroy, P. Müller, O. Pierre-Louis, New Journ. Phys. (2011)