



ESPCI
Laboratoire PMMH
10 rue Vauquelin, 75231 Paris Cedex 05



Séminaire PMMH

Bureau d'Études, Bâtiment L, 2^{ème} étage

Vendredi 4 novembre 2016, 11h00-12h00

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SIMM - ESPCI

Telephone Cords, parrot ladders, hexagons and the like - the unexpected morphologies of thin film buckles

Thin films with large compressive residual stresses and low adhesion are prone to buckling and delamination. This is both a significant technical issue, with relevance to thin film stability, and an interesting academic problem where (non-linear) plate mechanics couples to mixed mode adhesion. This coupling produces a variety of intriguing patterns. The most famous is the telephone cord, but other morphologies can appear as well.

We have carried out an experimental study of buckle formation on a model system : the film is a Molybdenum overlayer with thickness ranging between 50 and 300 nm, while compressive biaxial stress (up to nearly 3 Gpa) is adjusted through the deposition conditions. In addition a thin silver film (usually 10 nm) is deposited directly on the substrate, below the Mo layer : in this way a low and reproducible adhesion develops. With this system, we have obtained a wide range of buckling conditions. Beyond telephone cords we have also met with less ubiquitous morphologies, such as parrot ladders, branching buckles, hexagons... We have quite systematically explored the phase diagram of morphologies as a function of stress and thickness. To help understand these results, we have also modeled the formation of the buckles. Geometrical non-linearities of film buckling are taken into account through a Finite Element model, and film adhesion is included as a cohesive zone. We show that consistent predictions of the buckle morphologies are obtained provided the mode mixity dependence of interfacial toughness is taken into account. We have also numerically demonstrated that the period of the telephone cord buckle is directly connected to the mode I critical energy release rate G_{Ic} , and give some experimental evidence that in practice thin film adhesion energies can be measured quite accurately based on this observation. Finally we investigate other morphologies and in particular regular patterns resulting from branching.

Attention : pas de séminaire le Vendredi 11 novembre

Prochain séminaire : vendredi 18 novembre, Maximilien Levesque (ENS)

Programme des séminaires : www.pmmh.espci.fr, onglet *Séminaires PMMH*

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