EuroSciCon

17th Edition of International Conference on

Emerging Trends in Materials Science and Nanotechnology

April 26-27, 2018
Rome, Italy

Jérôme Colin, Nano Res Appl, Volume:4
DOI: 10.21767/2471-9838-C1-008

# MORPHOLOGICAL INSTABILITY OF THIN FILMS DEPOSITED ON SUBSTRATES

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**The main topic of this presentation is concerned with the study of the coupling between the mechanical properties of thin films on substrates and their morphologies. In a first part, the aging of the buckling patterns experimentally observed at the mesoscopic scale onto the surface of metallic thin films deposited on substrates is studied by means of finite element simulations (FEM). The conditions for the transition from straight-sided wrinkles to telephone-cords or circular blisters are first discussed. The problem of the shape instability of multilayered hyperelastic solids has been then considered and the in-phase and out-of-phase configuration for a thin layer embedded in a heterogeneous matrix has been discussed versus the elastic coefficients of the different neo-hookean materials. In a second part, the evolution of the vicinal surface of gold single crystals deformed by external uniaxial compression tests and *in situ* observed by UHV scanning tunneling microscopy is investigated (see figure 2). It is demonstrated that the slip traces resulting from the emergence of moving dislocations at the free surface highly modify the organization of the vicinal steps. A model based on energetic considerations is proposed and discussed to explain the observed phenomenon.**

Figure 1: Ni thin film on polycarbonate substrate

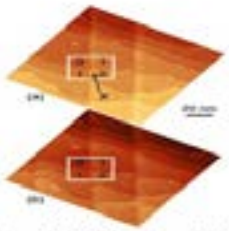

Figure 2: STM observation of gold

**Recent Publications**

1. **Coupeau C, Camara O, Drouet M, Durinck J, Bonneville J, Colin J and Grilhé J (2016) Slip trace-induced vicinal step destabilization. Physical Review B 93:041405.**
2. **Hamade S, Durinck J, Parry G, Coupeau C, Cimetière A, Grilhé J and Colin J (2001) Effect of plasticity and atmospheric pressure on the formation of donut and croissant-like buckles. Physical Review E 91:012410.**
3. **Ruffini A, Finel A, Colin J and Durinck J (2016) Effect of interface plasticity on circular blisters. Scripta Materialia 113:222-225.**
4. **Coupeau C, Durinck J, Drouet M, Douat B, Bonneville J, Colin J and Grilhé J (2015) Atomic reconstruction of niobium (111) surfaces. Surface Science 632:60-63.**
5. **Colin J, Coupeau C, Durinck J, Cimetière A and Grilhé J (2014) Re-deposition of a straight-sided buckle under pressure. Physical Review E 89:032410.**

## Biography

Jérôme Colin works in the field of the Mechanics of Materials and Materials Science. He is involved in modeling of the mechanical properties of nano-structured materials, thin films on substrates and coatings. More precisely, he has developed models in the framework of the elasticity and thermodynamics theories, to characterize the morphological evolution of layers under strain, the formation of atomic defects such as dislocations in strained nanostructures or the delamination and buckling of thin films on substrates.

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