

**MASTER Recherche**  
**2<sup>ème</sup> année**  
**Proposition de stage 2008/2009**

**Laboratoire:** Unité Mixte CNRS/Saint-Gobain (Surface du verre et interfaces (SVI) - UMR125)

**Adresse:** 39 quai Lucien Lefranc, BP 135 - 93303 Aubervilliers Cedex

**Directeur du laboratoire :** Elin SONDERGARD

**Responsables du stage:** Sergey Grachev et Jérémie Teisseire

**Téléphone:** 01 48 39 57 48 (S. Grachev), 01 48 39 55 41 (J. Teisseire) - **Fax :** 01 48 39 55 62

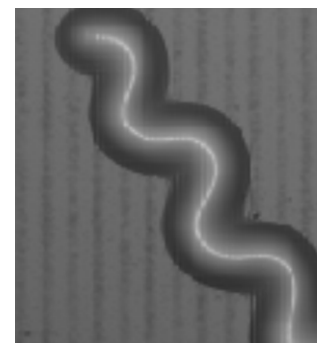
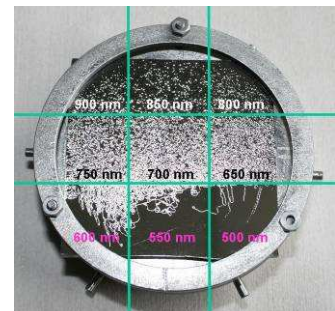
**e-mail:** [sergey.grachev@saint-gobain.com](mailto:sergey.grachev@saint-gobain.com), [jeremie.teisseire@saint-gobain.com](mailto:jeremie.teisseire@saint-gobain.com)

**Titre du sujet proposé : Thin film's adhesion and buckling.**

This project is concerned with the adhesion in stacks of thin films characterized by thicknesses in the range from a single atomic layer up to ~100 nm. Such films are widely used in glass industry as well as in micro-electronics, hard coatings applications and others. Thin films add certain functionalities to a product: optical, conductive/resistive, protective properties etc. However, a weak adhesion between films and the internal stresses may cause fracture of interfaces and the loss of functionality of the coating. This problem requires a rather precise measurement of the *interfacial toughness*.

A new technique for measuring the interfacial toughness is called the superlayer method. In this method, an additional layer under high compressive stress is deposited onto the tested stack of thin films. When the thickness of the superlayer exceeds a certain threshold, the fracture of a weak interface in the stack may occur. This results in the buckling of the upper part of the stack driven by the tendency of the system to release the stress. The threshold itself as well as the morphology of the buckles are used for modelling the mechanics of the phenomenon.

The superlayer methods described above is available in our lab and allows defining the threshold thickness in a single sample with thickness gradient (see figure 1). Establishing the connection between the buckle geometry and other parameters of the test (interfacial toughness, stress, elasticity of the superlayer and the films in the stack) will be the main goal of this project. For this, we will use both experimental and analytical (mathematical) approaches. The experiments will be performed in our laboratory by depositing the superlayers in a high vacuum chamber using sputter-deposition. The simulations and modelling will be done in collaboration with a laboratory in Poitiers University.



**Figure 1.** Superlayer adhesion test resulted in delamination of the coating in the form of the telephone-cord buckles.

**The objectives of these training are:**

- To establish the influence of the parameters of the test on buckling,
- To connect the threshold thickness to the interfacial toughness,
- To model the delamination process with the help of our collaborators.

**Used techniques:** Vacuum equipment, sputter-deposition, AFM, Microscopy,

Possibilité de poursuivre en thèse ? **Oui.** Mode de financement éventuel de la thèse ? **Cifre**

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