**Experimental study and numerical simulation of multi-cracking of thin films on compliant substrate**

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**Friday, January 26th 1:30 pm**

Amphitheater Jean Besson (Phelma campus)

**Jury:**

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| - M. Dominique LEGUILLON (DR émérite, CNRS, Université Pierre et Marie Curie) | Rapporteur |
| - M. Eric LE BOURHIS (Pr. Université de Poitiers) | Rapporteur |
| - M. Daniel Hanoch WAGNER (Pr. Weizmann Institute of Science) | Examinateur |
| - Mme. Muriel BRACCINI (CR CNRS, Grenoble INP) | Examinateur |
| - M. Guillaume PARRY (MdC Grenoble INP) | Directeur de thèse |
| - M. Davy DALMAS (CR CNRS, Ecole Centrale de Lyon) | Co-directeur de thèse |
| - M. Rafael ESTEVEZ (Pr. Université Grenoble Alpes) | Co-encadrant de thèse |

**Abstract**: Semiconductor coatings deposited on flexible substrates are used in various high-tech applications, for example flexible micro-electronic components or flexible solar cells. When submitted to large tensile strains, these coatings undergo damage characterized by the appearance of multiple cracks on their surface with or without delamination at the film/substrate interface. At the end of the multi-cracking process, a characteristic distance between cracks can be measured. This distance depends mainly on the thickness of the film and the mechanical behavior of the substrate.

In this project, an experimental study on oxide layers and oxide and silver multilayers with different thicknesses deposited on two polymer substrates was carried out. Were able to determine the mechanical behavior of each substrate and to identify the stages of the three stages of multi cracking of thin layers. A first stade of random appearance of cracks, a second stade of regular cracking and a last stade of saturation of the network of cracks were identified. The influence of the thickness of the silver layer has also been studied.

We have developed a 2D mechanical model using cohesive zones to simulate the initiation and propagation of cracks in the film. Using this model, we successfully simulate the three stages of the multi-cracking of oxide monolayers deposited on polymer as observed experimentally. We then reduced the model to a representative cell allowing only the last two stages of multi-cracking to be modeled. This cell allowed us to identify the influence of the geometric and mechanical properties of the thin layers and their substrate on the distance between cracks at saturation. The influence of interfacial delamination has also been studied.