Master 2: *International Centre for Fundamental Physics*

INTERNSHIP PROPOSAL

(One page maximum)

Laboratory name: Surface Verre et Interfaces
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Thesis possibility after internship: YES/NO
Funding: YES/NO If YES, which type of funding: CIFRE

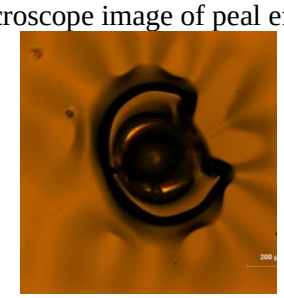
Study of skin formation during the drying of polymer solutions using Raman spectroscopy

One of the methods for depositing a thin layer on glass involves drying a previously spread liquid layer on the surface. During the drying process, vertical concentration gradients in solute can appear. This phenomenon is controlled by a Peclet number that compares a characteristic evaporation time to a solute molecule diffusion time. When this Peclet number is much greater than one, diffusion no longer homogenizes the solute concentration, and it accumulates near the air interface [1]. When the solute is an amorphous polymer, a glass transition driven by solvent concentration can occur near this interface, leading to the formation of a skin. The presence of a solid skin can have significant consequences on drying-related phenomena. In particular, recent observations show that the effect of defects on the final film morphology is likely altered by such a skin and can event strongly affect the impact of a defect (Figure 1). However, predicting the occurrence of the skin is challenging. The variations in the mutual diffusion coefficient of polymer/solvent are generally poorly understood because they are difficult to measure. Furthermore, the skin thickness can be thin, complicating its experimental detection.

In this internship, we propose to use Raman spectroscopy [2] to highlight the formation of skin during the drying of polymer solutions. Polymer/solvent pairs will be selected with the aim of obtaining a distinct Raman response for both components, and the polymer concentration profile within the thickness of a liquid film will be measures during the drying process. This internship could potentially lead to a CIFRE theses dedicated to studying the effects of skin formation during drying.

[1] A.F Routh, "Drying of thin colloidal films", *Reports on Progress in Physics*, vol 76, avril 2013
[2] B.S Tomar, A. Shahin and M.S Tirumkudulu,"cracking in drying films of polymer solutions", *Soft Matter*, vol 16, 2020

Figure 1: Optical microscope image of peal effects around a defect



Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES/NO Soft Matter and Biological Physics: YES/NO
Quantum Physics: YES/NO Theoretical Physics: YES/NO