# <u>PROJET de 3ème ANNÉE n°</u>

<u>Titre</u> : NANOMECHANICS OF SLOW CRACK PROPAGATION IN POLYMER SYSTEMS

<u>Nature et finalité du travail</u> :

Slow crack propagation in glassy polymers presents intensive inelastic deformation around the crack tip in a region of a few tens microns. Depending on the nature of the polymer network, the associated damage mechanisms can range from crazes (nanoscale fibrils joining the crack lips, such as in polystyrene) to shear bands (localized shear deformation, such as in epoxy resins) or both (PMMA).
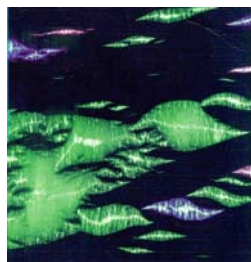
| Crazes | Shear bands |

The scope of the present stage is to develop and probe an experimental setup that combines a loading machine for propagating slow cracks in polymer samples and an atomic force microscopy (AFM) setup. In will thus be possible to image in real time the setup of the damage mechanisms at the crack tip providing very original information.

A similar technique has been successfully applied by the stage mentor in another laboratory (LCVN, Montpellier) to the study of slow cracks in silicate glasses in the stress-corrosion regime. The damage mechanisms were shown to act in a very small region of about 10 nanometres around the crack tip. The lower degree of brittleness of polymer glasses will imply on one hand a greater care in the crack propagation, but will provide on the other hand the manifestation of damage mechanisms at larger scales which are more easily accessible by AFM.

The first step of the stage will involve installing and practicing the new load cell. The second step will be to develop adequate techniques to propagate straight cracks into polymer samples. The third step will be to mount the load cell on an AFM and make preliminary observations of slow crack propagation at velocities of the order of 1 nanometre/s.

<u>Qualités requises</u> : Basic knowledge in fracture mechanics, polymer physics, informatics, atomic force microscopy

<u>Nombre d'élève</u>: **1**

<u>Encadrement du Projet</u> :

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<u>Laboratoire où s'effectue le projet, dans le cas où ce n'est pas dans un Laboratoire propre de l'École</u>