CEA Saclay –Service de Physique de l'Etat Condensé (SPEC) (page web)
Laboratoire *SPHYNX* (page web)

PROPOSITION DE STAGE 2023

CONTRIBUTION OF IMAGE ANALYSIS TO THE STUDY OF STRESS CORROSION BEHAVIOUR OF GLASS

Glass is a widely used material because of its many advantages: transparency, hardness, low thermal expansion, high melting point temperature, relative chemical inertia, etc. However, it has one major weakness: its fragility. Relatively moderate stresses can cause it to break suddenly, without any warning. Glass is also sensitive to the phenomenon of stress corrosion cracking : under the influence of certain environmental conditions (relative humidity, temperature, etc.). In this case, apparently harmless stresses (much lower than those leading to its sudden breakage) can lead to crack propagation at low rate, as observed in the slow cracking of car windscreens.

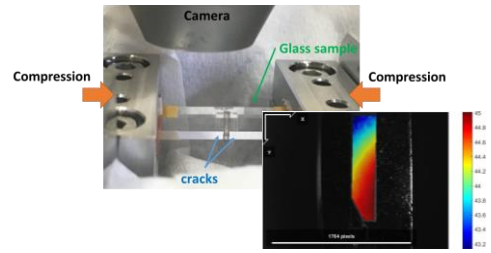

Figure 1 : detail of experimental set-up of stress corrosion cracking and first image of DIC obtained in silica glass

Recently, a methodology based on image correlation (DIC : Digital Image Correlation, see as example https://en.wikipedia.org/wiki/Digital_image_correlation_and_tracking) has been developed to acquire various quantities necessary (stress intensity factor, precise position of the crack tip, etc.) to identify the laws of fracture. It consists of speckling (i.e. depositing a pattern of randomly dispersed "spots") on the surface of a sample and studying by image analysis the displacement of these "spots" when the sample is mechanically stressed. This method has been developed for relatively soft materials (acrylics) and the transition to hard material such as glass is not easy. A change of scale is necessary (pattern with smaller "spots"). Techniques (deposition, etching, image acquisition…) have be tested by SPHYNX members and are fruitful.

The objective of this internship is to optimize and qualify the methodology based on DIC and recently developed in SPHYNX. In this context, the candidate will acquire stress corrosion cracking data for different glass composition: from pure silica to ternary glass (SiO_2-B_2O_3-Na_2O). He/She will be in charge of the different steps: speckling preparation in the SPEC clean room, implementation of mechanical tests on a dedicated experimental set-up and image analysis. The results will be compared to the ones already obtained in the laboratory or/and the published ones.

This internship will take place in the SPHYNX lab located in the *Condensed State Physics Service* which is a joint CEA / CNRS unit (UMR 3680 CEA-CNRS). Researchers study condensed matter physics, from the most fundamental physics to industrial applications. The candidate will have the opportunity to use and learn first-hand advanced methods for characterising materials and their surfaces, from the macroscopic to the nanometric scale. The approaches will be based on experimental platforms and theoretical tools developed in-house. The candidate will have the opportunity to manipulate theoretical and experimental tools used in the field of materials science, mechanics and statistical physics.

No further thesis work planned

CONTACTS: Laure Chomat, 01 69 08 79 32, Laure.Chomat@cea.fr
Cindy L. Rountree (web), 01 69 08 26 55, Cindy.Rountree@cea.fr
Daniel Bonamy, 01 69 08 21 14, Daniel.Bonamy@cea.fr