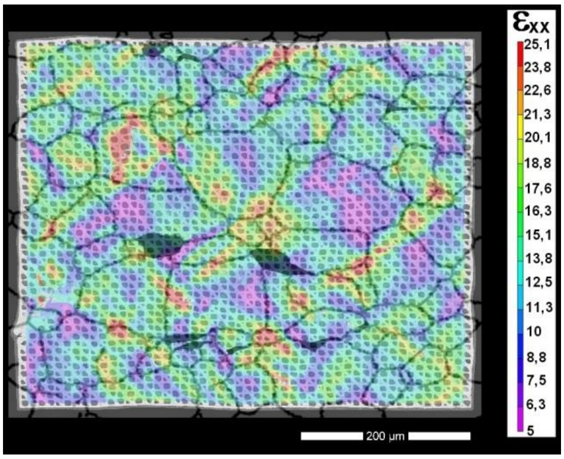
# Modelling stress corrosion cracking initiation of cold-worked austenitic stainless steels

**Qi HUANG**

(2016 – 2019)

**Partner:** Paris University 13, LSPM - Laboratory of processes and materials science

**Supervisors**: J. Crépin, C. DUHAMEL (Centre des Matériaux)
M. Gaspérini, Y. Charles (LSPM)




- Stress corrosion tests on 316L steel in a primary water environment
- Failure criterion to be identified
- Microstructural map by EBSD analyses, local deformation by DIC, intergranular oxidation depths and crack depths by FIB
- Stress fields at grain boundaries by crystal plasticity FE simulation

Low carbon austenitic stainless steels, such as 316L steel, have been selected as materials in contact with the primary environment of pressurized water reactors (PWRs) in nuclear power plants because of their good resistance to uniform corrosion at high temperatures. However, cases of intergranular stress corrosion cracking (SCC) on cold-worked stainless steels in PWRs were reported.

To better understand the link between corrosion, microstructure map, local mechanical fields and cracking network and to identify a failure criterion for oxidized grain boundaries by taking advantage of this link, SCC tests are performed in a primary water environment on cross-shaped specimens. This geometry is used to apply a loading path change, considered more severe in terms of cracking than a monotonous loading.

The microstructural fields and local deformation fields are followed throughout the various loading steps and correlated to the cracking network obtained at the end of the test. As both stress concentration and intergranular oxidation are supposed to play a key role in SCC initiation, the mechanical stress fields at uncracked and cracked grain boundaries are computed by crystal plasticity finite element (FE) simulation of polycrystalline aggregates generated from EBSD (electron backscattered diffraction) analyses, the experimental displacement fields being used as boundary conditions. In addition, the intergranular oxidation depths for uncracked grain boundaries and crack depths for cracked boundaries are expected by focused ion beam (FIB) cross-sectioning and imaging.