NOMATEN Hybrid Seminar

Location: NOMATEN seminar room
Time: 1 PM
gotomeeting room (for online): https://meet.goto.com/NCBJmeetings/nomaten-seminar
Seminar date: May 14th, 2024

Title: Irradiation embrittlement investigation and modelling in structural nuclear materials

Speaker name: Dr. Christian Robertson
Speaker affiliation: French Alternative Energies and Atomic Energy Commission (CEA), France

Abstract: Structural nuclear materials are subjected to neutron irradiation at elevated temperature, thereby affecting the operational lifetime of various critical reactor components. Dose-dependent material damage directly depends on dislocation-mediated plasticity mechanisms and their interactions with the irradiation defect microstructures, in the form of interstitial and vacancy clusters. Corresponding plastic strain spreading mechanisms have been investigated in details during the past few years, using three dimensional dislocation dynamics simulations. This particular talk focuses on how dislocation-scale data can be worked out and then applied to component-scale damage evaluation. Two applicative case study are presented herein:

1. Inter-granular crack initiation susceptibility in internal steels
2. Irradiation embrittlement in reactor Pressure Vessel steel

Bio: Engineering Degree (B. Ing.), Université de Sherbrooke (Canada). Master in Physical Engineering (M. Sc A), École Polytechnique de Montréal (Canada). Doctorate in Materials Physics, Université de Paris-6 (Ph. D.). Dissertation subject: "Déformation plastique induite par l'essai d'indentation sub-micronique dans le cuivre et l'acier 316L". Habilitation à diriger des recherches (HdR) in Materials Physics, Institut National Polytechnique de Grenoble (INPG). Dissertation subject: "Damage accumulation and crystal plasticity mechanisms in metallic materials". Pr. C. Robertson research activities focus on the observation and corresponding physical modelling of plasticity mechanisms in structural nuclear materials, at the grain and sub-grain scale (µm). These developments aim to give support and to improve component design rules and surveillance programmes of metallic materials, in the context of nuclear power reactor operation. The main tools utilized are Transmission Electron Microscopy, Dislocation Dynamics modelling and various mechanical tests including resilience, tensile, creep and fatigue. Various applicative cases have been investigated and presented in several peer-reviewed scientific papers (2004-2024):

1. Fatigue lifetime prediction under complex loading conditions
2. Prediction of dose-dependent fracture toughness evolutions (ductile to brittle transition temperature and upper shelve energy) in ferritic materials
3. Prediction of stress corrosion cracking initiation in post-irradiated austenitic stainless steels
4. Prediction of thermal and irradiation creep (residual) lifetime in heavily damaged metallic materials