Fall 2016 Joint Colloquium
Materials Department & Materials Research Laboratory

Dr. Henry Proudhon
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Centre des Materiaux
MINES ParisTech

Friday, September 30th, 2016
11:00 am, Elings 1601

Pizza served at noon.

Synchrotron X-ray imaging and diffraction for in situ 3D characterization of structural materials

The drive for innovation pushes forward better performance of materials in severe service environments. For structural materials, understanding the deep nature of plastic deformation and fatigue fracture as a function of the material microstructure is extremely important. Third generation synchrotrons (and free electron lasers in the future) are developing throughout the world to provide scientists with stable, high brilliant X-ray sources to investigate material problems. As such, the increasing popularity and capabilities of X-ray tomography to image the bulk of materials in three dimensions brings forward a new way to validate large-scale material simulations. For structural materials, the non-destructive nature of these tools enables mechanical stress rigs for in situ measurements. Recent experimental developments will be presented through several applications, including fatigue cracking in Al aerospace alloys and early plastic deformation of polycrystalline materials. Progress and limits in terms of spatial and temporal resolution will be discussed.

The incredibly rich knowledge brought at the micron scale by in situ imaging using either absorption, phase or diffraction contrasts, can often serve as direct input for full field simulations. One of the key challenges is therefore to link 3D microstructure characterization tools with computational models to predict engineering properties such as strength or fatigue resistance. This can be accomplished using direct measurement of 3D microstructures or synthetically generated images using sophisticated models to ensure representativity. Examples of image based large-scale computation using the crystal plasticity finite element method will be presented. Automated image processing, meshing strategy and the need for high performance computing will also be discussed.

Bio Henry Proudhon Graduated in 2001 from Ecole Centrale Lyon in France in Mechanical Engineering. He received his Ph. D. in Material Science in 2005 from INSA Lyon working on investigating fatigue cracking mechanisms with synchrotron X-ray tomography. He then went to the University of British Columbia to work with Prof. Warren Poole on fine grain materials and the Bauschinger effect. In 2007, he joined CNRS, the French national research for science institute, at Centre des Materiaux MINES ParisTech to carry out his research on Three dimensional study of deformation and fracture in polycrystalline materials: from synchrotron X-ray investigations to computational mechanics. In 2015 he defended his habilitation and also was associated to the DiffAbs beamline at the SOLEIL synchrotron near Paris. He is currently visiting Tresa Pollock's research group to work on Ni base superalloys and TiAl alloys.

http://matperso.mines-paristech.fr/People/henry.proudhon/

Hosted by Tresa Pollock.