DCAMM SEMINAR

APPLIED MATHEMATICS AND MECHANICS

FS921 5 September 2017

A DCAMM seminar No. 712 will be presented by

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The title of the lecture is

Homogenized models for nanoporous metallic materials

Abstract:

Materials used in nuclear power plants are subjected to extreme conditions such as high temperature, high pressure and more specifically high energy particles irradiation, leading to the formation of crystalline defects that are responsible for drastic evolutions of mechanical properties. In particular, voids can be formed, for example in austenitic stainless steels used for structural components, ranging from one-tenth of a micron down to few nanometers depending on irradiation conditions. Assessing structural integrity of irradiated components under applied stress thus requires developing homogenized models for micro/nano-porous materials. Homogenized models for porous materials have been developed and widely used for the last decades since the work of Gurson. However, recent theoretical considerations and numerical simulations have put forward that micro/nano-scale voids might behave differently due to various phenomena such as scarcity of dislocations sources, crystal-scale plasticity, geometrically necessary dislocations, presence of void/matrix interface.

In the first part of the presentation, a brief introduction to material challenges in nuclear environments will be given with an emphasis on irradiation-induced voids. Then, in a second part, two homogenized models will be presented to describe the mechanical behavior of materials with small scales porosities, including void/matrix interface stresses and strain gradient plasticity, respectively. Two dimension-less parameters are introduced comparing void size to relevant material length scales. Both models include growth regime - when voids do not interact - and coalescence regime - when voids strongly interact. In particular, yield criteria relevant for the coalescence regime obtained through limit analysis are detailed. The numerical implementation of these two models is described, leading to strain-stress curves for different levels of stress triaxiality and initial porosity. These simulations exhibit void size effects, and are compared to unit-cell simulations. In a third part, model experiments designed to assess nano-void deformation under mechanical loading are described, and preliminary results are discussed.

DATE: **Thursday, 14 September 2017**

TIME: **13:00 – 13:45 + questions**

PLACE: **Room 006, Building 450,**
DTU, Technical University of Denmark

Danish pastry, coffee and tea will be served 15 minutes before the seminar starts.

All interested persons are invited.

Niels Leergaard Pedersen