KTH SOLID MECHANICS KEYNOTE SEMINAR; Thursday, April 15th, 16.15; https://kth-se.zoom.us/j/68383628219

Alan Cocks' KEYNOTE seminar "Modelling Creep Deformation of Engineering Alloys at Different Scales"

In recent years there has been significant interest in the UK in the development of improved models of creep deformation and failure of engineering alloys, driven by the desire to extend the life of the UK fleet of AGR nuclear reactors. Due to recent decisions about the future of these reactors, this need is less pronounced, but important results have emerged from this research that are relevant to a wide range of engineering materials. In this talk, I will focus on modelling the plastic and creep deformation of engineering materials. The talk is divided into two parts. Initially, I will describe a physically based crystal plasticity/creep model embedded within a self consistent scheme that takes into account: the effect of dislocation structures, precipitates and solute atoms on hardening and recovery; and the role of internal residual stress states at different scales [1-2]. The model has a small number of material parameters that can be calibrated using 5 simple material tests. It will be demonstrated how the resulting model captures the material response under complex loading cycles typical of those experienced in AGR components [3]. The above fundamental crystal based models are relatively simple. An area where further development is required is in the way in which dislocations interact with particles. I explore this in the second part of the talk where I describe a discrete dislocation plasticity (DDP) formalism that models dislocation glide, cross slip and climb facilitated by diffusion along the cores of the dislocations (the dominant kinetic process at the temperature of interest) [4-6]. I will demonstrate how the balance between these processes and the detailed way in which dislocations bypass particles and influences the development of dislocation structures changes with stress [6]. I will also present models for the mobility and interaction of prismatic dislocation loops – that is important for the study of irradiated materials.

Alan Cocks is the Professor of Materials Engineering at the University of Oxford. Before moving to Oxford in 2006 he held academic posts at the Universities of Cambridge and Leicester in the UK and at the University Illinois in Urbana-Champaign in the USA. He obtained a BSc from the University of Leicester and was award a PhD in 1980 for his research at Cambridge on modelling creep fracture. In 2019 he was elected as a Fellow of the Royal Academy of Engineering in the UK. Alan's research mainly centres on the development of micromechanical models of deformation and damage development in engineering materials and the evaluation of structural behaviour under complex thermo-mechanical loading histories. He continues to work on material and structural behaviour in the creep range, and has also made important contributions in the areas of powder processing (flow, compaction and sintering), thermal barrier coatings and ferroelectrics as well as developing strategies for modelling microstructure evolution in engineering materials.

References

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