Imperial College London

Centre for Nuclear Engineering

CNE Newsletter – Dec 2012 *Issue 1*

Welcome to the first CNE newsletter, there have been many exciting developments in the CNE over the last few months and we thought that this would be the best way to let everyone know about them.

Brand New office space for the CNE

Thanks to the recent SIF money from IC we have now got a brand new CNE office in B303, Bessemer Building. It currently holds 3 academics, 6 RA's and 14 PhD students and we already have a waiting list!

3rd Annual EDF Lecture

The 18th October saw Vincent de Rivaz, CEO of EDF Energy give the 3rd Annual EDF Lecture at Imperial College, titled 'Time to Inspire a Generation'. It was a great success with over 200 people in attendance. The transcript of the lecture is on our website www.imperial.ac.uk/nuclearengineering/news_and-events.

New appointments

Dr Ben Britton, office RSM 118, has been appointed as a Fellow in Nuclear Engineering. Ben joins us from Oxford University. I am sure you will join us in welcoming him to Imperial College. Ben explains more about his research over the page.

New CNE Members

As well as welcoming Ben to Imperial College, we also welcome some new academic members to the CNE. From Chemical Engineering we welcome Benoit Chachuat, Christos Markides, and Marcos Millan-Agorio.

Good News!

The award was presented to Bill Lee (right) by ACERS President George Wicks (left)

Congratulations to Professor Bill Lee who has been awarded the annual W. David Kingery award by the American Ceramic Society. This award recognizes distinguished lifelong achievements involving multidisciplinary and global contributions to ceramic technology, science, education and art. Previous winners include Sir Richard Brook, Larry Hench, and Martin Harmer.

MSc Nuclear Engineering

This year we now have 18 MSc students (all of whom will be looking for projects!), over double the previous year's intakes.

UKNADM

As part of Robin Grimes's Nuclear Champion EPSRC grant, a UK Nuclear Academics Discussion Meeting was held in September. It was a huge success with 100 nuclear academics and industry representatives attending the Oxford Meeting.

Student Placements

If you have any contacts that would be willing to offer our nuclear UG's and MSc's students industry placements please could you contact Emma Warriss with the details.

Featured Research

Fellow, Dr Ben Britton introduces his research

I specialise in understanding the deformation behaviour of individual microstructure units in materials using micromechanical testing and through development of novel characterisation tools. These two approaches lend themselves towards isolating and testing single grains, interfaces or small ensembles of grains which can be easily analysed to validate physically based models. I have focussed on understanding power plant materials (Zr, Ti, Fe-based, and W) as well as leading development of High Resolution Electron Backscatter Diffraction (HR-EBSD). HR-EBSD enables us to measure elastic strains and lattice rotation at a length-scales between TEM and XRD with very high precision (1E-4 in strain and 1E-4 rads) in the SEM. A recent highlight has been the measurement of the resistance to slip transfer of an individual grain boundary using HR-EBSD. In the Nuclear Centre at Imperial College, I am going to continue this work through the development of in-situ deformation tools to explore the dynamic behaviour of materials and link observations to materials processing and performance, which are key for both component design and product lifetime prediction.

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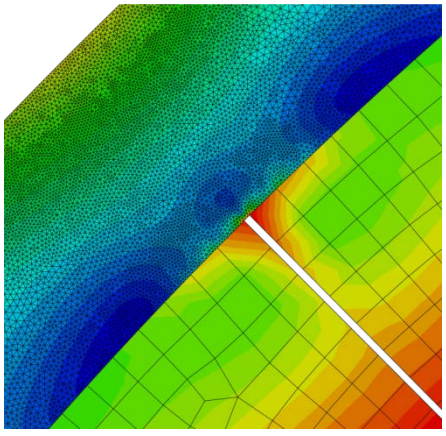
Rizgar Mella - PhD student with Dr Mark Wenman

During operation, the harsh environment within an Advanced Gas-Cooled Reactor (AGR) can lead to pin failure from thermal-mechanical interactions between the fuel pellet and the stainless steel cladding. Fuel pellets in AGR pins interact with the cladding through cyclic heating and contact pressure, and during operation, high friction, no-slip surfaces cause pellet-clad bonding, at the pellet-clad interface. The integrity of the fuels cladding has a serious operational and economic impact on nuclear plant performance.

I have been focused on the creation of a fuel performance code using the Finite Element Method (FEM). Solving for physical fields in FEM allows for the departure from the limitations of empirical relation based fuel performance codes. A reduction in the use of empirical material properties and leveraging modern modelling techniques permits the modelling of conditions where no experimental data exists or conditions in future reactors.

An extensible fuel model has been built on a commercial finite element package, ABAQUS. Capabilities include coupled temperature-displacement-diffusion and highly non-linear fuel cladding dynamics. The ABAQUS modelling package was further extended to include non-local material modelling permitting fuel performance modelling to extend into region previously forbidden by continuum mechanics allowing new fuel design concepts and fuel damage mechanisms to be discovered and explored.



Stress plot of post heat-up contact between the cladding and the fuel. Showing the enhancement brought to fuel performance modelling via the use of adaptive re-meshing within an industrially verified commercial modelling platform.