Un-irradiated UO_2 and MOX creep properties

V. BASINI[1] – A. MOCELLIN[1] - F. BRUGUIER[1] – JC. RICHAUD[1]
[1] CEA, DEC/SPUA/LMPC, Bdg 717, CEA/Cadarache, F-13108 St Paul lez Durance Cedex

The improvement of nuclear fuel performances in Pressurized Water Reactors (PWR) requires indeed an enhancement of creep ability of nuclear fuels in order to reduce the pellet induced strain to the cladding materials during the Pellets Cladding Interaction (PCI). Thus, creep is studied at intermediate temperatures by compression experiments on as fabricated nuclear fuel pellets.
To date, lots of thermo-mechanical properties studies have been done on uranium dioxide. Those realized at the French Atomic Energy Commission (CEA) allowed to establish a creep law on the whole range of parameters explored (temperature, stress, grain boundary, porosity). Since 1987, plutonium is incorporated into mixed oxide fuel (MOX) pellets to be recycled in PWR's. Therefore, the MOX behavior has to be studied and compared to UO_2. Because of plutonium radiotoxicity, all the equipments have to be implemented into glove-boxes, which is costly and restricting and makes these experiments much more complex and time-consuming than for uranium materials.
Moreover, the MIMAS (MIcronization MASter-blend) fabrication process leads to a very heterogeneous microstructure. The pellets are composed of two phases: (a) clusters of uranium-plutonium dioxide (whose size depends upon the fabrication process) diluted in UO_2 matrix. Consequently, creep properties measurements need more parametric studies. First, we had to evaluate the influence of the plutonium repartition and content on creep performance. As a final point, taking into account all of the experimental and microstructural parameters, a creep law will have to be established. This law will be used to model the fuel behavior in reactor.
In the presentation, we shall provide the experimental results obtain on uranium dioxide fuel and a steady-state creep model will be presented. Then, we will also present the recent results obtain on MOX fuels. A comparison of MOX and UO_2 creep properties will be done and the impacts on reactor behavior will be discuss.