NucE 497

Homework 5

1. This question regards creep, growth, and irradiation hardening in zircaloy cladding materials.
   1. Describe the difference between thermal creep and irradiation creep
   2. What are the kinds of defects that form in zirconium due to irradiation and where do they form in the crystal lattice?
   3. How do these defects impact growth?
   4. How do these defects impact irradiation hardening?
2. In this problem we will consider oxidation of zirlo cladding at 325 °C.
   1. At what time does the cladding reach transition, and what is the cladding thickness?
   2. Plot the oxide thickness vs time for one year. Plot it as a line after transition. Before transition, make a rough sketch of the profile.
   3. What is the weight gain due to the oxide formation in mg/dm2?
   4. What is the change in mass of the cladding due to the oxidation? The tube has an outer radius of 4.75 mm and a length of 2.5 m.
3. In this problem we will consider hydride formation in zircaloy cladding.
   1. A cladding with an initial thickness of 600 microns and has 20 wt.ppm initial H content undergoes corrosion to a total oxide thickness of 100 microns. What is the overall hydrogen content in wt. ppm if the hydrogen pickup fraction is 15%?
   2. Slide 15 of lecture 33 shows an expression for the wt.ppm of hydrogen that can stay in solid solution in the cladding. At a temperature of 325 °C, what fraction of the hydrogen from part a would precipitate out as hydrides?
   3. What temperature would the cladding have to be heated to in order put all of the hydrogen content from part a into solid solution?
   4. Make a sketch of the hydride distribution in a cross section of the cladding. Include the effect of having one region of the circumference with the oxide layer having flaked off.
4. CRUD