Second Hour Exam
NEEP-423
Nov. 17,1997

Points | Question

25 1.) After a short term irradiation (before restructuring) a metallurgical examination revealed that a fuel element had melted to 30% of its radius. Given a linear power rating of 800 W/cm, and a bulk coolant temperature of 500°C, what is the heat transfer coefficient across the gap (h_{gap})? Use the following:

$$\frac{k_{clad}}{t_{clad}} = 8 \frac{W}{cm^2 \circ C}$$

$$h_{coolant} = 10 \frac{W}{cm^2 \circ C}$$

0.D. of cladding = 7mm

Use Conductivity graph attached

15 2.) Given Figure 11.17, explain the significance of moving from the hyper to the hypostoichiometric form of the mixed oxide fuel on the performance of the fuel.

20 3.) What is the physical state (i. e., metallic or compound) of Rb in a UO_2 fuel at the outer edge (600°K) and at the inner hole surface (1500 °K)? Use the information in the accompanying diagrams.

	edge, T= 600°K	center, T= 1500 °K
hypostoichiometric		
hyperstoichiometric		

20 4.) Assume that you have 2 bubbles in perfect equilibrium ($\gamma = 1000 \frac{ergs}{cm^2}$) at 1000 °C; one which has a radius of 1500 Å and the other has r=1000 Å. The unit cell size is 3 Å and there is no external pressure.

Boltzmann's constant = $1.39 \times 10^{-16} \frac{ergs}{°K}$

a.) How many vacancies are initially tied up in the bubbles?

b.) If the two bubbles coalesce, what is the new bubble radius?

c.) How many vacancies are now tied up in the in the coalesced bubble?

20 5.) a.) Give 4 ways that a bubble trapped on a grain boundary can be detached.

b.) In which direction do bubbles move in a temperature gradient (dT/dx) and in a stress gradient ($d\sigma/dx$)?

c.) Generally, which has more of an influence on bubble movement in an oxide fuel temperature or stress gradients?