3.40J/22.71J
Physical Metallurgy
Problem set 5

Due 1:00 PM 11 May 2004 either in class or on line.

Problem A.
I do not like fig. 8.23, as all the high purities are piled up at the right end of the abscissa.

1. Replot as rex T(K) as the ordinate vs.-ln(100-%purity) as the abscissa and comment on the fit.
2. At what temperature is 99.999% pure Al predicted to recrystallize? Does this T sound reasonable? Explain your answer.
2. On the basis of the linear plot, what % purity would recrystallize at liquid nitrogen temperature, 77K? Discuss why you do or do not trust the extrapolation to this temperature.

Problem B
Use Eq. 16 from my coarsening paper to describe grain growth in annealed aluminum. Assume an initial grain size of 10 μm.. Use one of my pet rules of thumbs to take the boundary diffusivity as $10^{(-4Tm/T)}$ cm^2/s, where T_m is absolute melting point. Take $\gamma = 0.5$ J/m^2. a = lattice parameter. Suppose that you want a useful lifetime of a couple of years, or about 100 million seconds.

1. Suppose the aluminum is used at 200 C. What will the grain size be after the specified time? Discuss your result.
2. What is the maximum operating temperature if the grain size is to remain below 20 microns? Discuss your result.
3. Comment on the practicality of using an element as a structural material at temperatures above $T_m/4$.

Problem C
Do Problems 8.4, 8.5 in the text, RH&A.

Note: When I say "Discuss" give a couple of sentences of explanation. This discussion shows whether or not you understand your result and is a key part of the answer.