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3.205 Thermodynamics and Kinetics of Materials—Fall 2006

November 28, 2006

Assignment 10: Due 10 A.M. Thursday, December 7.

Note: Problem #1 is held over from Assignment 9. If you already answered it well you do not have to re-submit. If you wish to submit a revised answer you are welcome to do so.

1. In typical solid-state system,  $\Delta g_B = -2000$  J/mol and  $\gamma = 100$  mJ/m<sup>2</sup>. Calculate the critical size  $R_c$  and free energy barrier  $\Delta \mathcal{G}_c$  for homogeneous nucleation under these conditions. Assuming that the material is f.c.c. and has a lattice constant of 0.38 nm, how many atoms are there in the critical nucleus? Compare  $\Delta \mathcal{G}_c$  to  $76kT$ , assuming a nucleation temperature of 800 K. Is homogeneous nucleation likely under these conditions?
2. Please solve exercise 5.1 on page 379 of Porter and Easterling's *Phase Transformations in Metals and Alloys*.
3. Please solve exercise 5.3 on page 380 of Porter and Easterling's *Phase Transformations in Metals and Alloys*.
4. Please solve exercise 5.5 on page 380 of Porter and Easterling's *Phase Transformations in Metals and Alloys*.
5. Please solve exercise 5.10 on pages 380–381 of Porter and Easterling's *Phase Transformations in Metals and Alloys*.