Department of Materials Science and Engineering
Massachusetts Institute of Technology
3.14 Physical Metallurgy–Fall 2003

Problem Set #5

Due Wednesday, October 29, 2003

5.1 Problem 9.4

5.2 Consider a small (e.g., r = 10**b**) particle that causes strengthening as a result of particle-matrix surface area created by dislocations passing through the particle. Briefly describe how the strengthening effect of such a particle varies with the passage of successive dislocations. (Hint: "Look down" on the slip plane and consider the particle-matrix area created as a function of the number of dislocations cutting the particle.)

5.3 In an HCP metal, identify the geometrically unique interstitial sites, and determine if a solute atom in each site would interact with either edge or screw dislocations, or both.

5.4 In an alloy whose composition is Al-5wt% Cu, what is the maximum strength that can be achieved by solid solution strengthening? How would you process the material to achieve this strength at room temperature? (You may need to consult a phase diagram to answer this.)

5.5 In the same Al-5wt% Cu alloy, what is the maximum strength that can be achieved by precipitation hardening, assuming all precipitates have the same size and are uniformly spaced? (Again, you may need to consult a phase diagram to answer this.)