Homework #4
Due: 2/26/18

1. (30) Compute and plot the force vs. reduction in height curve for open-die forging of a cylindrical, annealed copper specimen 1 in. high and 1 in. diameter, up to 75 percent for the case of (a) no friction between the flat dies and the specimen, (b) $\mu = 0.1$, and (c) $\mu = 0.2$. Ignore barreling. Use average pressure formulas. Calculate the work done in each case. Determine the temperature rise in the specimen for each case, assuming that the process is adiabatic and the temperature is uniform throughout the specimen.

2. (20) If you section, polish and etch (to reveal grain structure) metal balls made by the process shown in Fig. 6.21, what would the grain flow lines look like? Explain your answer.

3. (20) A 2.0 in. thick slab is 10 in. wide and 12.0 ft long. The slab thickness is to be reduced in three steps in a hot rolling operation. Each step will reduce the slab to 75% of its previous thickness. It is expected that for this metal and reduction the slab will widen by 3% in each step. If the entry speed of the slab in the first step is 40 ft/min, and the roll speed is the same for the three steps, determine (a) the length and (b) the exit velocity of the slab after the final reduction.

4. (30) A flat, annealed 70/30 brass ($K = 500$ MPa, $n = 0.41$) wire is to be drawn from a 10 mm diameter cross-section to a 4 mm diameter cross-section. The die angle, $\alpha$, is 30° (be careful to use in radians where appropriate) and the lubricant is an emulsion, where $\mu = 0.1$. Calculate (a) the relevant flow stress, and (b) the drawing force (be sure to account for friction and inhomogenous deformation). (c) Check if the process is feasible. (Will yielding occur in the drawn wire?) (d) If not, suggest a way of achieving the required end result.