Homework Exercise (for discussion in class in about two weeks)

1. Read the following paper and comment:

    S.C. Lim and M.F. Ashby, Wear-Mechanism Maps, Overview No. 55, Acta Metallurgica, vol. 35, no.1, pp.1-24, 1987.

2. You have developed a new copper alloy that has titanium diboride (TiB_2) as second phase particles. The total volume fraction of TIB_2 is 3 %. The particle size is uniform throughout the matrix of copper. You made five samples by varying particle size as follows: 0.05 microns, 0.1 microns, 1 microns, 10 microns, and 100 microns.

    (a)   Estimate the hardness of each material.
    (b)   Estimate the wear coefficient of each sample, assuming that they wear by delamination.

    State your assumptions clearly.

3. A cam/follower system is designed to control the opening of a valve. To reduce the wear of a cam made of heat-treated 1045 steel, it was coated with a 5 micron thick TiC layer. The follower, which is made of 52100 steel and has a radius of 0.5 inches, slides on the cam. The load applied by the follower on the cam can vary from a low load to extremely high load. Describe how the cam coated with TiC is going to wear as a function of the applied load. Estimate the maximum load that can be applied by the follower without damaging the coating.