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

Quiz #2

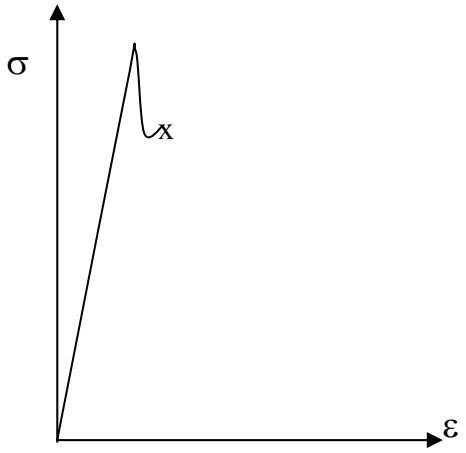
Problem #1:

In class we discussed the several separate contributions by which a small coherent precipitate can enhance the strength of crystals. Interestingly, it has also been found that a dispersion of small voids (say, 5-15 nm in size) can also strengthen metals; this is commonly called 'void strengthening'.

Explain how voids of this size can provide strengthening. Start by listing the ways that a precipitate promotes strengthening, and explain how each of these does or does not apply to a void.

Problem #2:

You have been hired as a 'special assistant' in a mechanical laboratory, where you mostly spend your time playing video games. However, one day you are asked to perform a tensile test on a "binary metal alloy". You start the test, and obtain the first part of a stress-strain curve:



Not expecting the large stress drop, you stop the test abruptly at 'x', and observe that the specimen has ***not*** *fractured and seems to be in fine shape. Although your mind is addled from spending months doing nothing but playing video games, you remember from your 3.14 days that this represents a rapid straining event, and you can think of two possibilities:*

1) *The stress drop results from twin formation*
2) *The stress drop results from breakaway of dislocations from solute atmospheres*

Unfortunately, you have virtually no resources at your disposal (i.e., no microscopes, analytical equipment, X-ray machine, etc.); all you really have is the tensile test machine. Propose a simple experiment that would allow you to unambiguously determine whether event (1) or (2) from above has occurred.