

## Midterm Exam #2 Study Guide

Midterm exam #2 is to be administered between 5 and 7 p.m. on November 4, 2008. The examination is to be comprehensive includes lectures, homework assignments and past in-class quizzes. The exam will be conducted in two parts: a closed-book section (about 40 minutes) and an open-book section (80 minutes). In the closed-book section, questions such as concepts, theories, and definitions will be employed. In the open-book section, problem analysis and calculation of specific property will be the focus. Below is a short list of chapter highlights to be covered in the exam.

### Chapter 5 **Strengthening of Crystalline Materials**

Concept of particle strengthening: strong vs. weak obstacles (Figure 5.2)  
Four strengthening methods: work hardening, boundary (grain size) strengthening, solid-solution strengthening and particle (precipitation) strengthening  
Interactions between atoms and a moving dislocation  
Particle hardening (IPB, interphase boundaries)  
Deforming and non-deforming particles  
Deforming particles (coherency hardening, modulus hardening, chemical strengthening, order strengthening)  
Definition of strain gradient hardening  
Why stress-strain curves for Cu, Cu-BeO and Cu-Be are different? (Figure 5.29)  
Skim section 5.9 (pages 221 – 230)

### Chapter 7 **High-temperature Deformation of Crystalline Materials**

Time-dependent deformation -- creep  
Two properties: creep rate and rupture time (definitions)  
Figure 7.2 Stress-temperature curve (involving time) very important  
Creep test: physical meaning of each stage (three stages)  
Recovery of creep strain and stress relaxation  
Physical mechanisms of creep  
Creep behavior in crystalline materials  
Four important creep mechanisms: dislocation glide at low temperature, diffusional flow (NH creep, Coble creep), combination of dislocation and diffusional flow, Creep in two-phase regions  
Deformation maps (applications), Superalloys (definition and applications)  
Superplasticity, Hot working of metals

### Chapter 8 **Deformation of Noncrystalline Materials**

The difference in their mechanical behavior between crystalline and noncrystalline materials  
Figure 8.2 discusses the volume-temperature relationship between amorphous and crystal materials  
The relationships among glass transition temperature, melting temperature and cooling rate  
Temperature and stress effect on material flow  
Deformation behavior of glass (Section 8.4)  
Deformation behavior of metallic glass (Section 8.5)  
Deformation behavior of polymers (Section 8.6)  
Crystallinity – stretch effect, cross-linking, crazing vs. yielding