MT30001, Autumn 2016, IIT Kharagpur

Date on which the problems were given: 15 August 2016

Submit your assignment in the class of 22nd August 2016

Assignment 1:

1.
   a. What are the driving forces for each of the following: a) Recovery b) Recrystallization c) Grain growth?
   b. What are the differences between recovery and grain growth?
   c. What are the differences between cold working and hot working?
   d. Why is recrystallization easy for a material undergone higher degree of cold working?

2.
   a. How can you increase both strength and toughness (or, ductility) of a single phase polycrystalline material?
   b. Write down and explain the governing equations for
      i. Grain boundary strengthening.
      ii. Solid solution strengthening
      iii. Strain hardening
      iv. Precipitation strengthening for an incoherent precipitate
   c. What do you mean by crystallographic texture? State a method of forming crystallographic texture in a material.
   d. Among the following pairs which one is stronger and why?
      i. Single crystal vs. Poly crystal
      ii. Pure metal vs. an alloy
      iii. Single phase material vs. multi-phase material
      iv. Fine distribution of incoherent precipitates and coarse distribution of incoherent precipitates (same volume fraction of precipitates)
      v. Fine distribution of nano-sized coherent precipitates or coarse distribution of nano-sized coherent precipitates with same volume fraction of precipitates (assume particle shearing by dislocation is the deformation mechanism)

3. Consider a single crystal of silver oriented such that a tensile stress is applied along a [001] direction. If slip occurs on a (111) plane and in a $[\bar{1}01]$ direction, and is initiated at an applied tensile stress of 1.1 MPa, compute the critical resolved shear stress.

4.
   a. Write down one common Titanium alloy giving its composition. Where is it used?
   b. Write down a few applications of Ti alloys.

5.
   a. Write down a few techniques for fabrication of integrated circuits (IC).
   b. Write down names of a few elemental and compound semiconductor materials.
   c. Explain the structure of carbon nano-tube. State its applications.