

MATE 201

Fall 2019

Homework #2

Due date: October 21st, 2019

(lecture time)

No late submissions!

Group submission (up to 4 students per group) is allowed.

Your homework submission should have a cover page which contains the following information;
your name, student number, course name, homework number and date of submission.

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Question 1:

Calculate the % change in volume when a piece of pure metal M changes its crystal structure from FCC to BCC upon cooling. Assume that there is no change in atomic radius R during the transformation.

Question 2:

Determine the linear density values (*in atoms/nm*) for tungsten in the [100], [110], and [111] directions. Which of these directions is the most closely packed?

2

Question 3:

Determine the planar density for the (020) plane of nickel.

Question 4.

Find

- the number of vacancies/cm³ and
- its density

if a piece of chromium (Cr) has five vacancies per 1000 unit cells.

3

Question 5:

Calculate the equilibrium number of vacancies in one cubic meter of Pb at its melting temperature of 327°C. Take the energy for vacancy formation as 0.55 eV/atom. Lead is an FCC metal with an atomic weight of 207.2 g/mole. Assume a density of 10.86 g/cm³ at 327°C.

Question 6.

What is the ASTM grain size number of a plain carbon steel that has 3000 grains/mm² ?

4

Question 7:

Molybdenum forms a substitutional solid solution with tungsten.

a) Compute the number of molybdenum atoms per cubic centimeter for a molybdenum-tungsten alloy that contains 26.4 wt% Mo and 73.6 wt% W.

b) Find the density of this alloy

The densities of pure molybdenum and tungsten are 10.22 and 19.30 g/cm³, respectively. The atomic weights of molybdenum and tungsten are 95.94 and 183.85 g/mol, respectively.

Question 8:

A diffracted x-ray beam is observed from the (311) planes of aluminum at a 2θ angle of 78.3° when x-rays of 0.15418 nm wavelength are used. Calculate the lattice parameter of the aluminum.

Question 9: Fill in the blanks

- Substances in which measured properties are independent of the direction of measurement are
- There are two types of solid solutions; and
- The magnitude and direction of the lattice distortion associated with a dislocation is expressed in terms of a
- The relative orientations of Burgers vector and dislocation line are (1) for edge, (2) for screw, and (3) neither perpendicular nor parallel for
- An atom is called when it has a tendency to accept valence electrons.
- The atomic packing factor of thestructure is the same as that of the structure, which is 0.74.
- The interface separating two adjoining grains having different crystallographic orientations is called a
- Most crystalline solids are composed of a collection of many small crystals or grains; such materials are termed