Crystallography Overview for MEMS
Final Assessment

Participant Guide

Introduction

The purpose of this assessment is to determine your understanding of crystallography, silicon crystal structure, and Miller Indices as it relates to microsystems technology and fabrication.

There are 15 questions

1. Which of the following BEST defines Crystallography? The science of …
    a. developing arrangements for atoms in solid matter.
    b. determining the arrangement of atoms in solid matter.
    c. studying the properties of atoms in solid crystal.
    d. developing new crystals using atomic structures.

2. Matter without a regular arrangement of atoms is called…
    a. Amorphous
    b. Chaotic
    c. Polycrystalline
    d. Crystalline

3. In a crystal, the simplest repeating section of atoms is called the
    a. Single crystal
    b. Poly crystal
    c. Unit cell
    d. Crystal seed

4. Polycrystalline solids consist of small crystals called _____, that are separated by _____.
    a. Unit cells, cell boundaries
    b. Amorphous solids, amorphous boundaries
    c. Single crystals, crystal boundaries
    d. Grains, grain boundaries

5. What type of solid is peanut brittle?
    a. Amorphous
    b. Chaotic
    c. Polycrystalline
    d. Crystalline

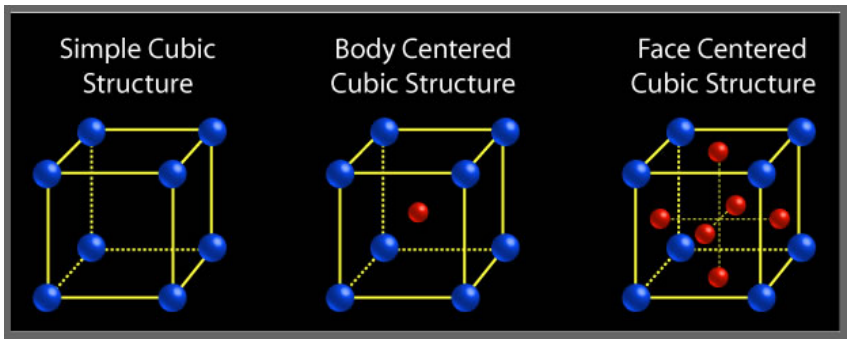
6. Which of the following is NOT a characteristic of monocrystalline silicon?
    a. Longer range order compared to polycrystalline silicon
    b. Well-ordered silicon atoms arranged in a lattice structure
    c. Many single crystalline solids held together by ionic bonds

7. The material properties of a silicon wafer are determined by surface atoms and the _____ of the silicon wafer.
    a. crystal orientation
    b. doping concentration
    c. long range order
    d. bandgap

8. What is the roadmap or compass called for identifying the crystal planes of single crystals?
    a. X-ray diffraction
    b. Crystallography
    c. Miller Index
    d. Cartography

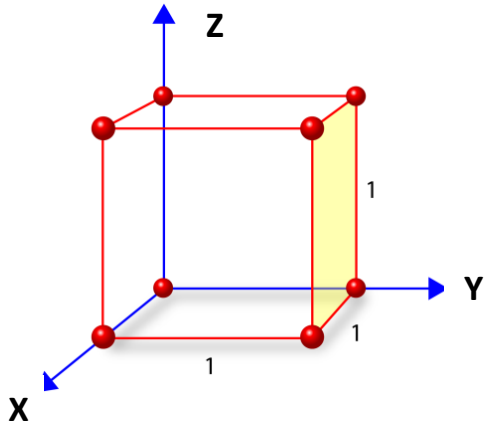
9. Which of the following BEST describes why crystalline silicon is used for microsystems fabrication?
    a. Readily abundant and can be easily formed into polycrystalline ingots and cut into wafers
    b. Its relatively short range order, strength, and unique ability to be etched along grain boundaries
    c. Its semiconductor properties that allow it to act as an insulator or a conductor depending on design
    d. Its unique electrical and mechanical properties that make it possible to form specific well-defined structures

10. There are different configurations for unit cells with each configuration having different number of atoms. A face centered cubic structure has how many atoms?
    a. 1
    b. 4
    c. 7
    d. 15

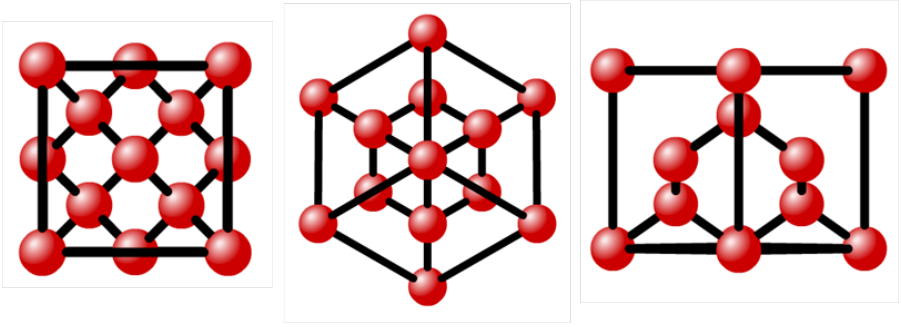


11. A silicon atom has _____ valence electrons that are shared with _____ other silicon atoms when forming a crystal.
    a. 8, 8
    b. 6, 2
    c. 4, 4
    d. 2, 6

12. What is the Miller Index notation for the yellow plane in this diagram?
    a. (100)
    b. (010)
    c. (001)
    d. (110)
    e. (111)



13. The following diagram represents different _____ in the same crystal structure.
    a. Grains
    b. Unit cells
    c. Growth structures
    d. Crystal planes



14. In the manufacture of silicon wafers, the crystal orientation of the wafers is determined by the…
    a. purity of the silicon
    b. orientation of the seed crystal
    c. type of seed crystal
    d. pull rate of the ingot

15. The bulk modulus of a microsystems structure is determined by the _____ properties of the material in which they are constructed.
    a. dimensional
    b. electrical
    c. mechanical
    d. optical

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