Crystalline Structure

Lesson Topic: Crystalline Structure

Objective of Lesson: To learn the terms amorphous, polycrystalline, and crystalline.

Reading Assignment: Chapter 1

Discussion Questions:

1. Compare and contrast amorphous, polycrystalline, and crystalline semiconductors in terms of material quality and in terms of cost.
2. Why can we not form a compound semiconductor from gallium (Ga) and tellurium (Te)?

Homework: None

What do you need to know for the exam?

1. Chapter 1 is one of those chapters we have to basically skip in order to fit all into a semester. You can read all or part of it at your discretion. There are important concepts in there, but we just don’t have time.
2. Know what amorphous, polycrystalline, and crystalline semiconductors are.
3. Know how to construct a semiconductor from elements in the periodic table.

Summary
Atoms in a solid are arranged into three classifications: amorphous, polycrystalline, and crystalline. These classifications have to do with the long- and short-range order of the atoms. This lesson discusses these different arrangements, their relative production costs, and their applications.

Crystalline Structure
The arrangement of the atoms in a solid is broken down into three classifications: amorphous, polycrystalline, and crystalline. These classifications have to do with the long- and short-range order of the atoms. A crystalline structure has a repeating pattern of arrangement of atoms over a very long range. An amorphous material has very little order, and in fact will have very different properties compared to a crystalline structure even if it is made from the same element. Polycrystalline semiconductors are in the middle.

Another term you may encounter is multi-crystalline. It is another class that is between polycrystalline and crystalline.

The cheapest arrangement is amorphous with no recognizable long-range order, while the type most common in devices and the most expensive arrangement is crystalline from which integrated circuits are made. It is an interesting fact that solar cells can be made from all of
these arrangements.

Silicon is the most common semiconductor material being used today because it the most abundant and can be found in all three arrangements.

The topics related to Miller indices are very important, but are not needed in the rest of the course so we skip it. Take a quick read through that. The section on growing of crystals is limited by the technology of a book. If you want to really appreciate it, you need to see a video of the process.

The text handles these simple ideas just fine so there is not much to add. See the demo linked below to see a 3-D animation of figure 1.4 in your text.

Useful other links
Bonding model

Definitions
Crystal: A homogenous solid formed by a repeating, three-dimensional pattern of atoms, ions, or molecules and having fixed distances between the repeating patterns.