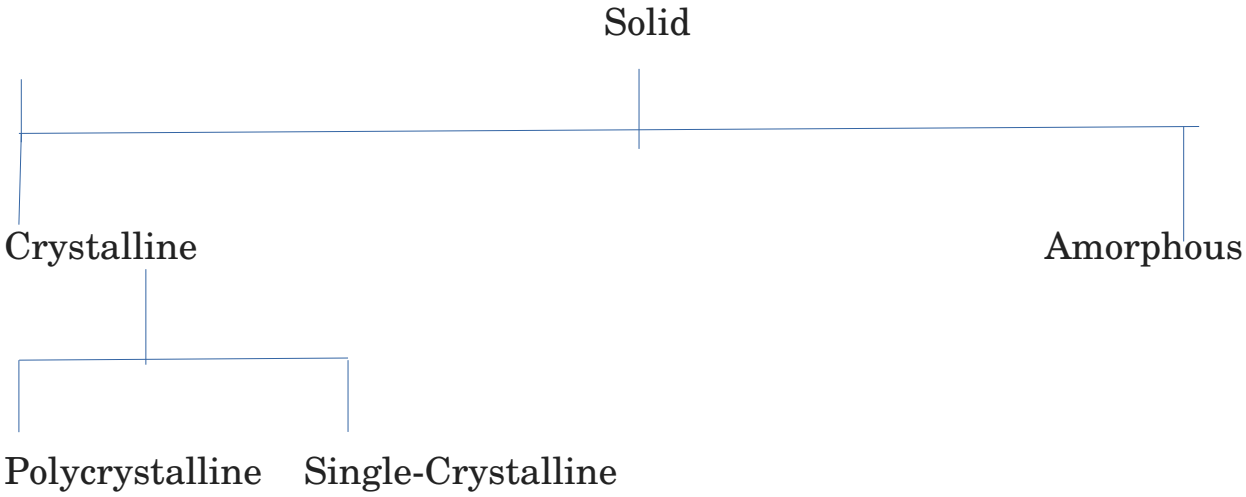
Introduction to Solid State Physics:

Solid-state physics is the study of matters in solid state using different tools of physics like quantum mechanics, crystallography, electromagnetism, and metallurgy. It is the largest branch of condensed matter physics. Solid-state physics studies how the large-scale properties of solid materials (Magnetic Properties of Solids, Dielectric Properties of Solids, Ferroelectric Properties of Solids, Superconductivity) result from their atomic-scale properties (Crystal Structure, Elementary Lattice Dynamics, Electron States in Solids). Thus, solid-state physics forms a theoretical basis of materials science.

What is Solid? Solid materials are formed from densely packed atoms, which interact intensely. In this state , the materials are not fluid but retain their boundaries without support, the atoms or molecules occupying fixed positions with respect to each other and unable to move freely. The intense interaction between the atoms/molecules produce the mechanical (elasticity is solely a property of solid material), thermal, electrical, magnetic, optical properties of solids.

As we said earlier in this course, we will first learn about some theoretical modelling in atomic scale and then with help of those theories, we will try to explain different macroscopic properties of solids. The first step of mathematical modelling is study about crystal structure.

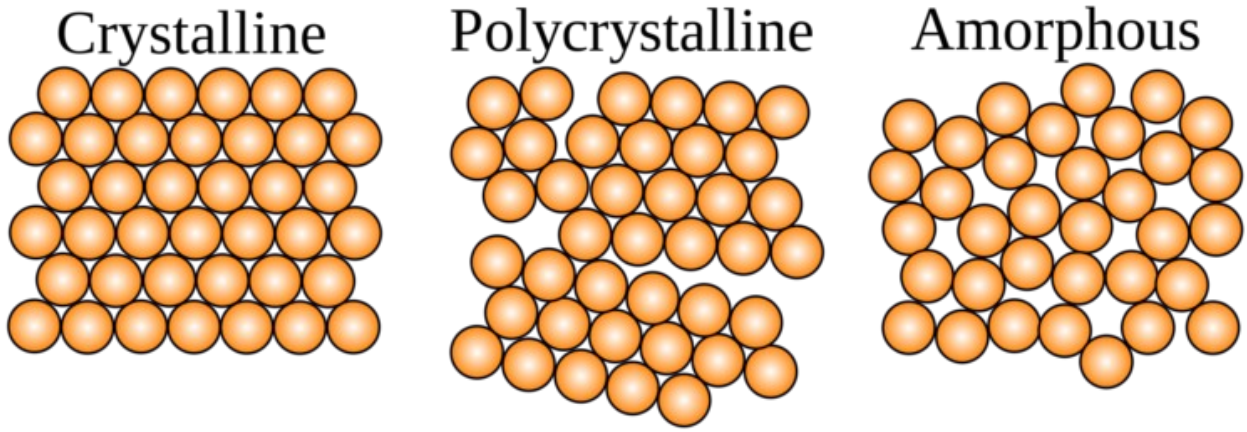


Thus on the basis of size of the ordered region solid materials can be classified into two diferent types 1. Crystalline materials and 2. Amorphous Materials.

Crytalline Materials: A material can be called crystalline when the constituent atoms or molecules or ions are arranged in regular or periodic manner forming a 3-D pattern which may be obtained by a 3-D repetition of a building block (unit).

When the regularity or periodicity of the pattern extends throughout the piece of the material it is known as **single crystalline**. But in most of the cases a piece of matter consists of a large number of small crystal section (**Grain**) of various shapes or sizes packed in one another in a quite irregular way along the interfaces called the **grain boundaries**. These materials are known as **polycrystalline** material. The size of grain can vary from a few Angstroms upwards. Example: Metals, diamond, ionic salts like NaCl.

Amorphous Materials: A material can be called as amorphous when there is practically no order in the arrangement of constituent part or the order is comparable to the pattern unit. Example: Glass, plastics, various polymers, wax.



Questions:1. What is Solid? How is it different from fluid?

2. According to periodicity or regularity how solid materials can be distinguished?

3. Define single crystalline, poly crystalline, amorphous with examples.

4. what do you mean by grains and grain boundaries?