LECTURE 2

TYPES OF SOLIDS

1) AMORPHOUS SOLIDS → NO PERIODIC STRUCTURE
   → WAX, GLASS

2) CRYSTALLINE SOLIDS → 3D PERIODIC ARRAY OF ATOMS
   → DIAMOND, C, SUGAR

3) POLYCRYSTALLINE SOLIDS → MISORIENTED STRUCTURES
   → METAL POWDERS
Two Types of Crystalline Solids

1) Elemental → C, Ge, Si → IV
2) Compound → GaAs, InP → III-V

Crystal Lattice

The atoms are arranged in a periodic fashion

1) Simple Cubic

* Each corner atom contributes to \( \frac{1}{8} \) to the unit cell

\[
\text{# of atoms per unit cell} = \frac{8 \times \frac{1}{8}}{1} = 1\text{ atom}
\]
2) **Body Centered Cubic** (BCC)

\[
\text{Simple Cubic + 1 in the center of the cube}
\]

3) **Face Centered Cubic** (FCC)

\[
\text{Simple Cubic + 1 in the center of each face}
\]
4) DIAMOND STRUCTURE

Each atom has 4 neighbors.

\[ a_{si} = 0.5431 \text{nm} \]
Top view of elemental diamond structure

Compound diamond structure
[ ZINC BLende CRYSTAL STRUCTURE]

GaO

As

GaAs
Compound Crystalline Semiconductors

1) Binary Compounds \( \text{IIIA-V} \)
   - GaAs, AlP, InP

2) Ternary Compounds \( \text{IIIA-V} \)
   - \( \text{GaAs}_x \text{P}_{1-x} \) 
     \( \% \) \( \% \)

   \( \text{Al}_x \text{Ga}_{1-x} \text{As} \rightarrow \text{Al}_{0.2} \text{Ga}_{0.7} \text{As} \)

* This is done to improve electrical and optical properties
In GaN $\rightarrow$ 405 nm BLUE LASER

AlGaInP $\rightarrow$ 635 nm RED LASER POINTER

GaAlAs $\rightarrow$ 785 nm CD DRIVES

AlGaAs $\rightarrow$ 1064 nm FIBER OPTIC COMM.

InGaAsP $\rightarrow$ 1480 nm PUMP FOR OPTICAL AMPLIFIERS