Tuesday, January 08, 2013
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LECTURE 3

TYPES OF SOLIDS

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

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

3) POLY CRYSTALLINE SOLIDS → MISORIENTED STRUCTURES → METAL POWDERS

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TWO TYPES OF CRYSTALLINE SOLIDS

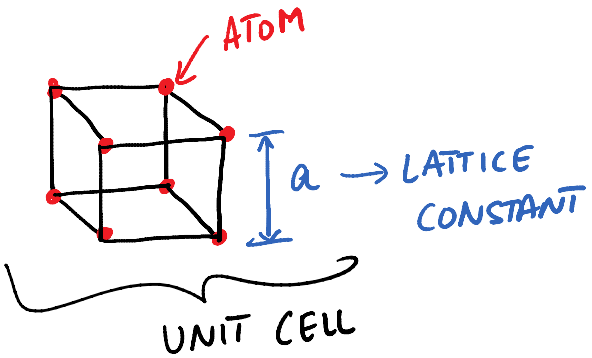
1) ELEMENTAL → C, Ge, Si → IV

2) COMPOUND → GaAs, InP → III-V

CRYSTAL LATTICE

THE ATOMS ARE ARRANGED IN A PERIODIC FASHION

1) SIMPLE CUBIC



* EACH CORNER ATOM CONTRIBUTES TO $\frac{1}{8}^{TH}$ TO THE UNIT CELL

∴ # OF ATOMS PER UNIT CELL = $8 \times \frac{1}{8} = 1$ ATOM

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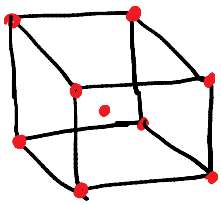
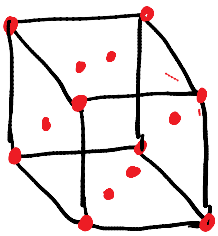
2) BODY CENTERED CUBIC
BCC



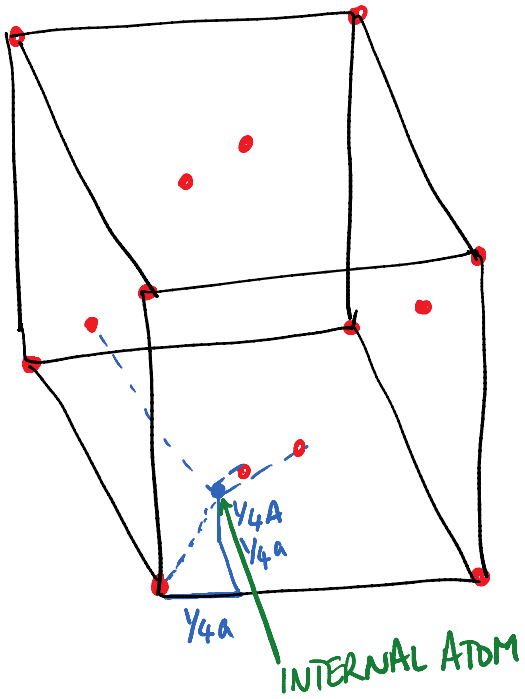
SIMPLE CUBIC +
1 IN THE CENTER
OF THE
CUBE

3) FACE CENTERED CUBIC
FCC



SIMPLE CUBE +
1 IN THE CENTER
OF EACH FACE

4) DIAMOND STRUCTURE



EACH ATOM HAS 4 NEIGHBORS

$a_{Si} = 0.5431\,nm$

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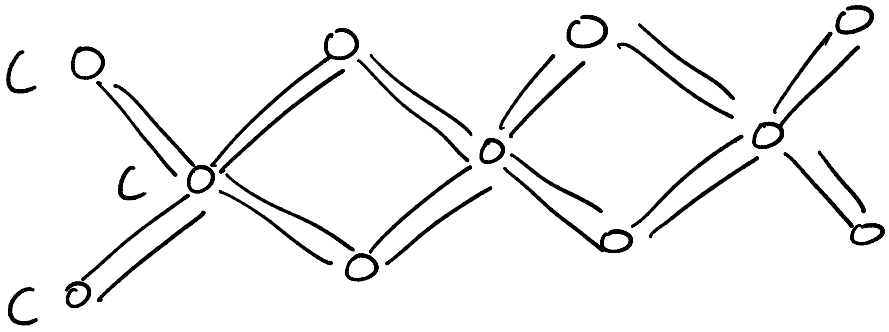
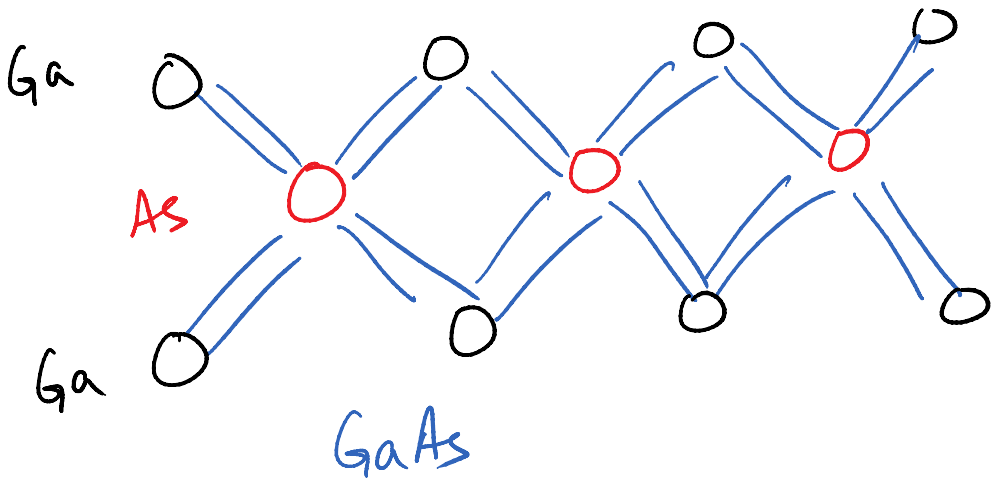
TOP VIEW OF ELEMENTAL DIAMOND STRUCTURE



COMPOUND DIAMOND STRUCTURE
[ZINC BLENDE CRYSTAL STRUCTURE]



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COMPOUND CRYSTALLINE SEMICONDUCTORS

1) BINARY COMPOUNDS III-V

GaAs , AlP , InP

2) TERENARY COMPOUNDS III-V

$GaAs_x P_{1-x}$

% %

$Al_x Ga_{1-x} As \rightarrow Al_{0.3} Ga_{0.7} As$

* THIS IS DONE TO IMPROVE ELECTRICAL AND OPTICAL PROPERTIES

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InGaN → 405nm BLUE LASER
BLUE RAY DISC PLAYER

AlGaInP → 635nm RED LASER POINTER

GaAlAs → 785nm CD DRIVES

AlGaAs → 1064nm FIBER OPTIC COMM.

InGaAsP → 1480nm PUMP FOR OPTICAL AMPLIFIERS