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PHYSICS

Material Science
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Module.2: Classification of Ceramic Materials



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1. Learning Outcomes

- **In this module,**
 - You shall learn about the information of Ceramic Materials.
 - You shall learn about Classification of Ceramic Materials
 - You shall learn about Structures of Ceramic Materials
 - You shall learn about CsCl, NaCl, ZnS etc.,



1.1 Introduction

- Ceramics is derived from the Greek word keramos, which means "burned clay".
- Ceramics – Inorganic, combination of metallic and non-metallic materials
- Large possible combinations → wide range of ceramics
- Most of ceramics are silicates, aluminates, oxides, carbides, nitrides or hydrides

1. 2 Classification of Ceramic Materials

1) Traditional Ceramics:

- Composed of naturally occurring basic components like clay, silica and feldspar
- Ex.: Clay -
- finely crushed, wet and moulded
- becomes rigid when heated at high temp.
- Products: porcelain, stone ware & earthen

2) Structural Ceramics:

- Used in constructions
- Ex.: Bricks, tiles, cement, concrete, sewer pipes etc.

3) Refractories Ceramics:

- Used at high temperatures
- Used in making parts of furnaces, ovens & apparatus operating at high temperatures

4) Fine Ceramics:

- Used for domestic, electrical and lab purposes
- Ex.: Dishes, white wares, electrochemical porcelain, chemical wares etc.

5) Modern & Special Ceramics:

- Used for specific purposes and also important applications in industries
- Used in the field of medicine, electronics, communication, transportation etc.

1.3 Structure of Ceramic Materials

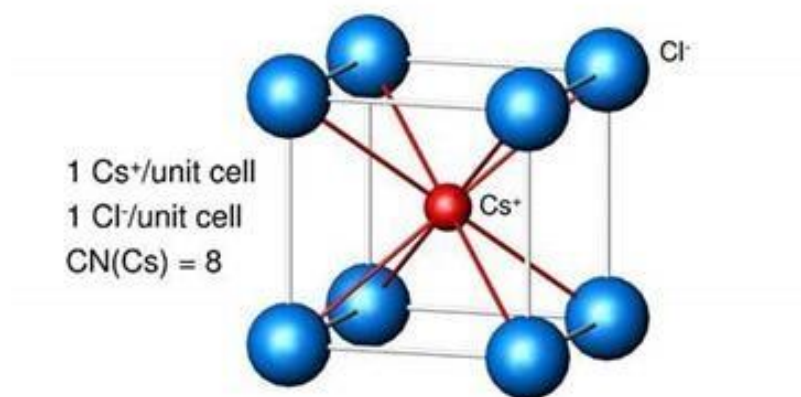
- Most of ceramics have crystal structures
- Formed by pure ionic, pure covalent or mixed ionic & covalent bonds
- Ionic bond: give relatively high stability & therefore high melting point
- Covalent bond: gives high hardness, high melting and low electrical conductivity at room temperature
- Crystal structure of ceramics is more complex
- Some common crystal structures are: CsCl, NaCl, ZnS etc.,



1) Cesium Chloride (CsCl) Structure:

- Unit Cell: Two interpenetrating SC lattices; with Cl ions arranged in SC structure & all Cs ions at occupied at interstices
- Coordination number: 8

Cesium Chloride



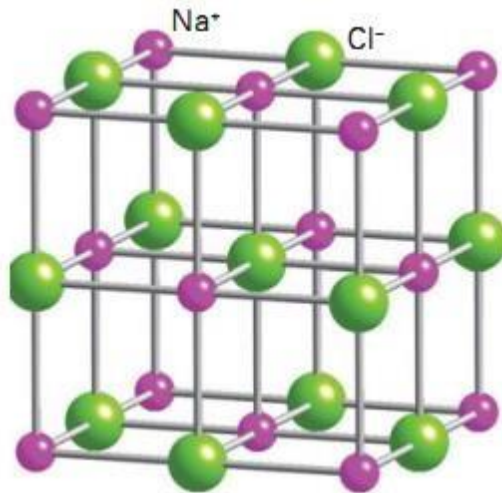
Ref. Image: [Cs chloride crystallises in cubic unit cell with cl ions in corner and CS ions in the](#)

[centre of cube how many CsCl molecules are there in unit cell? - Quora](#)



2) Rock-salt (NaCl) Structure:

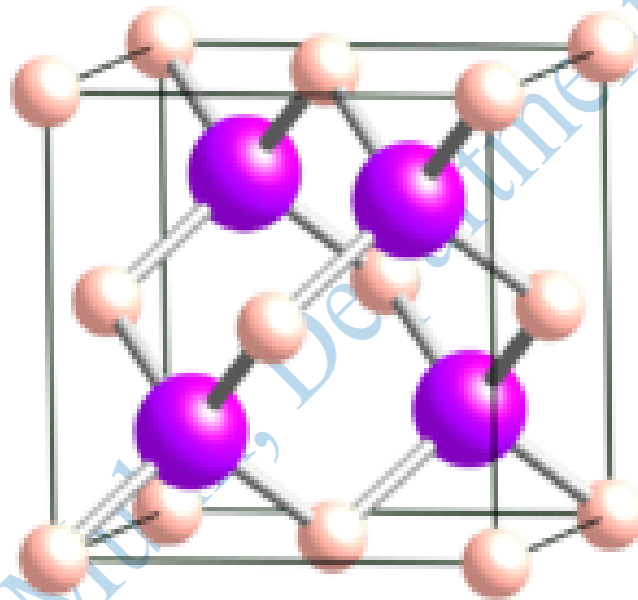
- Most oxides and halides crystallize in this type
- Unit Cell: Two interpenetrating FCC lattices; FCC anions with cations at all available interstitial positions; 4 cations and 4 anions per unit cell; one unit cell consists of 8 small cubes
- Each metallic atom is surrounded by six non-metallic atoms and vice versa
- Coordination number: 6:6



Ref. Image: [Chemistry: Rock-salt structure \(openchemistryhelp.blogspot.com\)](http://openchemistryhelp.blogspot.com)

3) Zinc Blend (ZnS) Structure:

- Unit Cell: Two interpenetrating FCC lattices occupied by different elements; FCC structure of S with Zn at interior tetrahedral position
- Coordination number: 4



Ref. Image: [6.11E: Structure - Zinc Blende \(ZnS\) - Chemistry LibreTexts](#)

1.4 Summery

- Most of the ceramic materials are crystallite structures
- The Crystal structure of ceramics is more complex
- Coordination number of CsCl is 8
- Coordination number of NaCl is 6:6
- Coordination number of Zinc Blend is 4

Homework

Multiple Choice Questions :

1. Ceramics are -----materials

(a) organic, metallic

(b) inorganic, non-metallic

(c) inorganic, metallic

(d) organic, non-metallic

2. The Coordination number of Zinc Blend is-----

(a) 4

(b) 4.4

(c) 6

(d) none of these

3. Covalent bond in ceramic materials has low ----- conductivity at room temperature.
- (a) magnetic
 - (b) electrical
 - (c) both electrical and magnetic
 - (d) none of the above.

Feedback :

References

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