Rock salt also known as NaCl is an ionic compound. It occurs naturally as white cubic crystals. The structure of NaCl is formed by repeating the unit cell. It has an organized structure and has a 1:1 ratio of Na:Cl.

**Introduction**

Rock salt (NaCl) is an ionic compound that occurs naturally as white crystals. It is extracted from the mineral form halite or evaporation of seawater. The structure of NaCl is formed by repeating the face centered cubic unit cell. It has 1:1 stoichiometry ratio of Na:Cl with a molar mass of 58.4 g/mol. Compounds with the sodium chloride structure include alkali halides and metal oxides and transition-metal compounds. An important role to many important applications is structure and dynamics of water. Some applications include crystallization of proteins and conformational behavior of peptides and nucleic acids.³

**Structure**

This picture shows how the Na⁺ and Cl⁻ ions occupy the space. The smaller ions are the Na⁺ with has an atomic radius of 102pm, and the larger ions are the Cl⁻ with an atomic radius of 181pm. Since NaCl are one to one ratio as a compound, the coordination numbers of Na and Cl are equal. In the picture above, the larger blue ions represent Cl⁻ and the smaller purple ions represent Na⁺. However, the structure of this molecule allows their positions to be switched since the coordination numbers are equivalent.

**A unit cell**

The unit cell of NaCl consists of Na⁺ ions and Cl⁻ ions. There are four types of site: unique central position, face site, edge sites and corner site, which are used to determine the number of Na⁺ ions and Cl⁻ ions in the unit cell of NaCl. When counting the number of ions, a corner site would be shared by 7 other unit cells. Therefore, 1 corner would be 1/8 of an ion. A similar occurrence happens with the face site and the edge sites. For a face site, it is shared by 1 other unit cell and for an edge site, the ion is shared by 3 other unit cells. NaCl is a face centered cubic unit cell which has four cations and four anions. This can be shown by counting the number of ions and multiplying them in relation to their position.

\[
\text{Na}^+ = 1_{\text{center}} + 12_{\text{edge}} \times \frac{1}{4} = 4_{\text{total}}
\]

\[
\text{Cl}^- = 4_{\text{face}} \times \frac{1}{2} + 8_{\text{corner}} \times \frac{1}{8} = 4_{\text{total}}
\]
Each ion in this lattice has six of the other kind of ion as its nearest neighbors, and twelve of the same kind of ions as its second nearest neighbors. There are many ionicly bonded molecules that take this structure including all other halides of Na, Li, K and Rb. CsF, AgF, AgCl, BaO, CoO, and SrS are also among many that will form similar structures to NaCl.

Outside Links

- Video about structure of NaCl: http://www.youtube.com/watch?v=csfOBynrF8E
- Unit Cell. http://www.case.edu/artsci/chem/chim...ids/xtal1.html

References


Problems

1. Which type of unit cell is NaCl?

(Answer: face centered cubic unit cell)

2. What corresponds to the 1:1 stoichiometry ratio of NaCl?

(Answer: NaCl is a face centered cubic unit cell which has four cations and four anions which results in the 1:1 NaCl ratio.)

3. Which ion would occupy the lattice point of the unit cell and why?

(Answer: Since the size of sodium ions is much smaller than the size of chloride ions, the chloride ions will occupy the lattice point.)

Contributors

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