

Lab 6: Properties of Solids and Bond Types

Introduction

Groups of atoms are held together by attractive forces called chemical bonds. Chemical bonds are important because the type of chemical bond that occurs in a molecule or substance in part defines its properties. For example, consider sodium chloride (NaCl) and hydrogen chloride (HCl). Both substances contain chlorine but NaCl is a white crystalline solid and HCl is a foul smelling gas.

How can this be if both materials have chlorine in them? The chemical bonding that takes place in NaCl is different than that in HCl. This gives NaCl and HCl very different structures, appearances, and properties.

An ionic compound is formed when metals lose electrons to non-metals resulting in the formation cations and anions. The oppositely charged ions arrange themselves in a tightly packed, 3-D structure called a crystal lattice. Covalent bonding occurs when two non-metals share electrons. Metallic bonding occurs between metal atoms. The valence electrons in a metallic bond are free-floating and are shared between the metal atoms (referred to as the electron sea model).

Purpose

To investigate the physical properties of common solids and to relate a substance's bonding type to properties observed in the lab.

Materials

Aluminum metal (Al)	Unknown solid	Toothpicks	Mortar and Pestle
Sodium Chloride (NaCl)	4 test tubes	Well Plate	Distilled water
Sucrose (C ₁₂ H ₂₂ O ₁₁)	1 test tube holder	Conductivity tester	
Ice (H ₂ O)	Bunsen burner		

Procedure

1. Place a small scoop of each substance in the well plate and test the conductivity of each substance in its solid state. (Please make sure to turn off the device when finished.)
2. Add a few drops of distilled water to each well and stir with a toothpick (use a separate toothpick for each solid). Record if the substance dissolves in water.
3. Test the conductivity of the **LIQUID** in the well. Do not let the probe touch any solid material left in the well. Record your results.
4. Place a small amount of each solid into a test tube. Using a test tube holder, place it over the flame and try to melt it. Record the amount of time it takes to melt the ice. **STOP TIME AT THE FIRST SIGN OF LIQUID.**
5. Place each substance one at a time in the mortar and pestle. Try to grind up the substance. The more brittle the substance the easier it is to grind. Record how brittle it is. Wipe out the mortar and pestle with a paper towel before adding the next substance.

Data/Observations

	Sucrose	Ice	Sodium chloride	Aluminum	Unknown
Type of bond (based on formula)					
Conductivity (solid)					
Solubility					
Conductivity (dissolved)					
Melting Point (time) (low, medium, high)					
Brittle (yes/no)					

Analysis

1. Summarize the lab results in the following table:

	Ionic Bonds	Covalent Bonds	Metallic Bonds
Melting point (high, medium, low)			
Soluble (yes/no)			
Conducts electricity (yes/no. If yes, in what state)			

2. What type of bonding exists in the unknown solid? Use data collected from the lab to explain how you arrived at the answer.

