Conductivity of Solutions and Solids

Purpose

To demonstrate that by passing electric current through an ionic solution, a light will glow, but by passing electric current through the solid form of the same substance, it will not glow.

Materials

U-tube made from Tygon Tubing	Ammonium chloride
Clamp	Dry ice
Conductivity apparatus	500 mL beaker

Procedure

1. Half fill a U-tube with an ammonium chloride solution (dissolve 10 grams of NH_4Cl (s) in 100 mL of solution).
2. Clamp the U-tube to the conductivity apparatus.
3. Place an electrode in each end of the U-tube. The light will glow brightly.
4. Place the U-tube in a slurry of dry ice and acetone.
5. Repeat the conductivity test. Notice that the bulb will eventually cease to glow as the temperature drops and the solution freezes.

Additional Information

1. The ammonium and chloride ions in solutions will conduct a current, and the bulb will glow:

   $NH_4Cl\ (aq) \rightarrow NH_4^+\ (aq) + Cl^-\ (aq)$

2. When the solution is frozen by the dry ice, the ions are fixed in position and are unable to conduct a current. Thus, the bulb will cease to glow.
3. If a U-tube is not available, bend a piece of glass tubing or connect two pieces and connect them with a short piece of tygon tubing.

Questions for the Students

1. Which ion carries the negative charge through the solution?
2. Would molten NaCl conduct electricity?

Disposal

Solution can be poured down the drain with excess water.

Reference

Summerlin, L.R., Borgford, C.L., & Ealy, J.B. Chemical Demonstrations, Volume II, 1987.