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Melting Point

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Overview

One of the most important properties of a crystalline solid is its melting point. It can be used to determine the purity of a known compound and gives important information about the stability of the formed crystals.

Principles

Solids can mainly be found in an ordered structure (crystalline solid) or an unordered structure (amorphous solid). Crystalline solids will organize themselves in a crystal lattice. Removing atoms or molecules from this lattice requires energy. Therefore, transferring an atom or molecule from the crystalline solid phase to the liquid phase takes energy in the form of heat. The melting point is the amount of energy in the form of heat, that is necessary to remove atoms or molecules from the crystal lattice.

Not all molecules will crystallize in a single crystal lattice. Some organic molecules are known to crystallize in different lattices that are similar in energy. Theses solids are called polymorph. They don't have a defined melting point but rather a range of temperature, where the solids melts.

Another factor that can influence the melting point are impurities. In most cases the melting point of a sample will decrease when containing an impurity. Measuring the melting point can therefore give a qualitative measure of the purity of a known sample.

Measuring the melting point requires a special apparatus, mostly a copper block that can be heated electronically. The temperature can be taken from an electronic sensor or a thermometer.

Procedure

1) Sample preparation
   a) Take a special glass capillary that fits the melting point apparatus, you are using
   b) Dip the open end of the capillary into a sample of benzoic acid
   c) Let the glass capillary bounce on a hard surface, like a table, so that the benzoic acid moves down to the very bottom of the glass capillary
2) Measuring the melting point
   a) Insert the glass capillary into the melting point apparatus
   b) Heat the apparatus with a rate of 10 °C/min until getting close to the expected melting point
   c) Decrease the rate than to 1 °C/min and observe the sample closely
   d) Record the temperature when the sample starts to melt and when it's completely molten

Representative Results

A sample of pure benzoic acid will melt at 122 °C.

Summary

The melting point is an important property of a crystalline solid. It can be measured easily and gives information about the identity, purity and also about the bonding strength within the crystal lattice.

Applications

Due to its simple determination, the melting point is still an important property that is commonly employed to identify compounds and qualify their purity. The melting point can not only be used to identify solids, but also liquids like isopropanol. Through derivatization of isopropanol with 4-nitrobenzoic acid to its corresponding ester, the derivative becomes a defined solid with a melting point, which enables now the identification.