Lower Merion High School Chemistry

Molecular Size
Lab 2

During the course of this lab you will determine the size of a single molecule of an organic compound we will call X. I have chosen to call it X because the identity of the particular compound is not important, rather it is the process and the end result that is most important and interesting.

In order to understand the process by which we will determine the molecular size of X we will do a simple lab exercise using aluminum foil first. In this sample lab you will find the thickness of a piece of aluminum foil, using your knowledge that density = mass/volume and that
volume = area x thickness.

To determine the molecular size, you will use a solution of an unknown, X. The solution is made of a small amount of X dissolved in ethyl alcohol. Although X dissolves in alcohol, it does not dissolve in water. Ethanol readily mixes with water however. The result of these different behaviors is that when the drop of the mixture hits the water, the ethanol will enter the water and go below the surface, while the X will ride on top of the water. Because X has very little attraction for itself, it will then spread out until it forms a very thin layer, theoretically a single layer one molecule thick. In order to determine the size of this layer, we will coat the surface of the water with a hydrophobic (water fearing) powder that will allow to see the layer formed.

Materials:

Aluminum Foil	Ruler	Balance
Plastic tray	Water	Talc or lycopodium powder
Solution of X in ethanol	Dropper	10 mL graduated cylinder

Procedure:

Cut a small square of aluminum foil and measure its length and width. Weigh the foil on the balance and then look up the density of aluminum. Do the calculations listed below for aluminum.

Take a round plastic tray and place enough water in the tray to form a thin layer that covers the entire tray. Sprinkle lycopodium (flash) powder or talcum on the water. The powder is hydrophobic, that is it does not mix with water, and will form a "dry" layer on the surface. Add a drop of the X solution to the center of the powder layer. Measure the diameter of the circle formed (quickly) and note the measurement in your notebook. Dump the water, ethanol, powder, and X mixture down the sink and rinse the tray well with water.

Using the same dropper (or an identical one) count the number of drops required to put exactly 5 mL into the graduated cylinder.

Calculations:

Calculate the area of the foil. If the foil is not square you will have to use your geometry knowledge to calculate an accurate area. Calculate the volume of the foil and then its thickness.

Determine the volume of a single drop.

Calculate the area of the circle formed by the layer of X.

Your instructor will give you information that will allow you to calculate the volume of the X in the layer. Use this information and the area to calculate the thickness of the layer. If you have done the calculations correctly this will be the length of a single molecule.