IMS School Lecture

Macromolecular "fluids" and liquid crystals

Prof Qi Wang (Florida State University)

Prof Wang is currently Professor of Mathematics, Director of Applied Mathematics Program at the Florida State University. Many remarkable materials are produced through processing of complex fluids, e.g. high performance light weight polymeric materials like vectran and kevlar that have been used widely in industrial and military applications, household materials, like egg yolks, glues, shampoos, ketchups, and many more in our daily life. Due to their complex molecular compositions and intermolecular interaction, the materials may exhibit fascinating mesoscopic structures in equilibrium and transient leading to extraordinary material properties. His research focuses on developing mathematical models to analyze the flowing materials and simulate their flow phenomena in various flow geometries.

Abstract

Many flowing materials in nature and in the world of man-made materials are made of "large" (macromolecular) molecules or inclusions (micro or nanosized particles). Sometimes, it is hard to call them liquids anymore because they flow very slowly. Do you know how fast KETCHUP flows? Several tens of miles per year!

These macromolecular fluids exhibit many properties between a "true" fluid and a solid. Can you imagine materials like playdoughs are actually complex fluids? All these are due to their microstructural compositions and intermolecular interactions. Due to the molecular interaction among the macromolecular molecules and/or inclusions, the materials may show quite distinctive behavior than the liquids that one is familiar with such as water, cooking oil, etc.

For example, if you disturb some polymeric liquids using a rotating rod, you will see the materials climb up along the rod. This is the well-known rod-climbing phenomenon for complex fluids. You can experiment with it at home with eggs and an egg-beater or other household materials. When the materials are extruded from a tube, they swell due to the relaxation of the elastic stress. Also, you can suck them up with a capillary tube even if the tube is pulled well above the averaged surface of the fluids.

Liquid crystals are macromolecular fluids of rigid molecules that can form partial orientational order and are sensitive to external fields. Because of it, liquid crystal display devices (LCD) have been widely used in computer monitors, TVs, high resolution display devices these days. High strength and high performance materials like vectran are manufactured commercially from liquid crystal materials. In this talk, I will introduce the some complex fluids and their fascinating properties and discuss how we can model them mathematically.

Date: 12 Jan 2005, Wednesday
Venue: Raffles Girls' School
Time: 2 to 3pm

Jointly organized

Institute for Mathematical

Raffles Girls' School

Institute for Mathematical Sciences
National University of Singapore
3 Prince George's Park, Singapore 118402, Tel: +65 6874 1891, Fax: +65 6873 8292
Http://www.ims.nus.edu.sg