

# Lectures in Chemical and Biological Engineering

## X-ray Scattering Studies of Flow-induced Alignment in Polymer Nanocomposites



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Polymer nanocomposites are a new class of materials, in which a nanoscale particle is dispersed in a polymer matrix. These materials are of increasing interest because of significant property enhancement achieved at small volume fraction of the nanoparticles. Often these nanoparticles are of anisotropic shapes like discs (clay) and rods (carbon nanotubes). The anisotropic shape of the nanoparticles causes them to align when subject to various flow conditions during processing. Since the physical and thermal properties of the nanocomposites strongly depend on the alignment of the nanoparticles, it becomes essential to develop methods to characterize and predict nanoparticle alignment during flow. In this talk I would like to present a part of my work which deals with characterization of flow induced alignment in model multi-walled carbon nanotube (MWNT) dispersions during simple shear flow. Flow induced structural measurements were made on a number of samples in the vorticity (1-3) and flow gradient (1-2) plane of simple shear flow using in-situ x-ray scattering techniques. Time resolved measurement of structure was made possible by the high intensity and brilliance of synchrotron x-ray radiation, where these experiments were conducted. In this study we have considered several factors which could affect flow dynamics like concentration and aspect ratio. The nanocomposites showed shear dependent structural states which were unique and reproducible. Among some of the most interesting results were extremely long transients to reach steady state, partial relaxation of anisotropy when flow was stopped, and significant quantitative differences in anisotropy measured by SAXS and WAXS.

**Thursday October 8<sup>th</sup> at 4:00PM in Tech LR4**

The Technological Institute

2145 Sheridan Road

Refreshments will be served at 3:45 PM