ME MTech (Res) Thesis Colloquium

Brownian Motion in Complex Fluids

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ABSTRACT

The motion of microscopic particles, either active or passive, suspended in a fluid contains rheological insights into the microscopic constitution of matter. For passive particles, this motion is also called Brownian motion, and it can be used as a tool for rheological measurements and provide insight into the mechanical response of a wide range of materials. As compared to liquids with simple constituent molecules, liquids containing macromolecules can exhibit significant viscoelasticity, reflecting the ability of these microstructures to both store and dissipate the deformation energy. It is here that study of Brownian motion of colloidal particles suspended in such complex fluids can prove to be very useful. In this work, particle tracking is employed to study rheology of polymeric fluids. Micron-sized probes, undergoing Brownian motion when suspended in a fluid, are used to locally deform the medium and trajectory of individual particle is observed using a high-speed camera. The dynamics of particle motions are then revealed through the mean-squared displacement (MSD) of individual tracer particles. To quantitatively relate the measured MSD of tracer probes to the rheological properties a generalized Stokes-Einstein relation is used. This provides a way for quantifying the material's linear viscoelastic response as the bead evolves in a continuum. Later, Brownian motion of passive particles is compared with motion of active colloids (bacteria), near a glass surface and a soot covered superhydrophobic surface. The measurements show that active colloids can demonstrate super-diffusive motion and can provide insights into colloid-interface interactions.

ABOUT THE SPEAKER

Dibyendu Mandal obtained his Bachelor's degree in Mechanical Engineering from Dayanand Sagar College of Engineering, Bengaluru in 2016. He joined the M. Tech (Res) programme at IISc in August 2017. His primary research interests are in microscale flows and behavior of polymeric fluids.

November 10, 2020, 2:00 PM, Microsoft Teams