MAR16-2015-004764

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Deformation and transport of micro-fibers and helices in viscous flows

ANKE LINDNER, PMMH-ESPCI, Paris, France

Fluid-structure interactions between flexible objects and viscous flows are, to a large extent, governed by the shape of the flexible object. Using microfabrication methods, we obtain complex "particles" in fiber and helix form with perfect control not only over the material properties, but also the particle geometry. We then perform an experimental study on the deformation and transport of these particles in microfluidic flows. Fibers are shown to drift laterally in confined flows due to the transport anisotropy of the elongated object. When these fibers interact with lateral walls, complex dynamics are observed, such as fiber oscillation. Fiber flexibility modifies these dynamics. Flexible microhelices are easily stretched by a viscous flow and we characterize the overall shape as a function of the frictional properties. The deformation of these helices is well-described by non-linear finite extensibility. Due to the non-uniform distribution of the pitch of a helix subject to viscous drag, linear and nonlinear behavior is identified along the contour length of a single helix. When a polymer solution is used for the viscous flow, an interesting multiscale problem arises and the typical polymer size needs to be compared not only to the global size of the helix, but also to the dimensions of the ribbon.