Platelet and micelle orientation for laminar liquid jets

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We investigate the orientation of sodium hectorite nanoplatelets and cylindrical micelles at the nozzle of a liquid jet by means of computer simulations. The laminar pipe flow is calculated by using 3D Lattice Boltzmann method. At the nozzle of the liquid jet a transition between no-slip and free-slip boundary conditions is applied (see figure 1). Experimentally, liquid jets can be produced by microfluidic devices.[1]

The orientation profile of the colloidal particles as a function of the flow rate is obtained by calculating Herman's orientation function describing the degree of orientation between a reference axis and a characteristic vector of the colloidal particle. At the transition between no-slip and free-slip boundary conditions we observe a reorientation of the platelets within a characteristic length scale (see figure 2). Important parameters influencing the reorientation are the applied pressure gradient and the aspect ratio between platelet size and channel radius.

In addition, the rheological behavior of the colloidal suspension is studied by determining the shear-rate dependent viscosity.

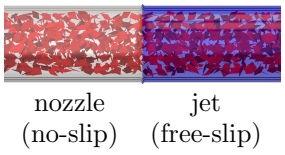

Figure 1: Simulation setup for nanoplatelets flowing through a cylindrical pipe.

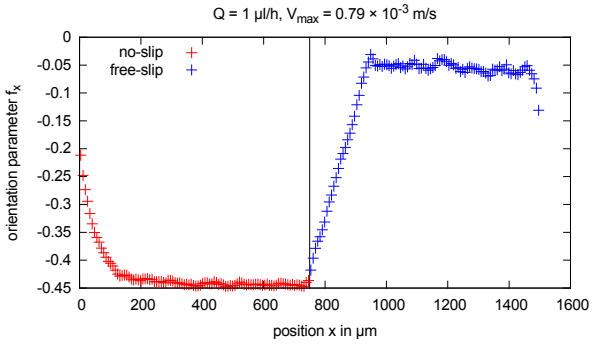

Figure 2: Platelet orientation at the nozzle of a liquid jet.

[1] Martin Trebbin et al. "Microfluidic liquid jet system with compatibility for atmospheric and high-vacuum conditions". In: *Lab Chip* 14 (10 2014), pp. 1733–1745.