MASTER THESIS PROJECT IN SOFT MATTER PHYSICS
Systematic investigation of the effect of complex flow fields on nanocellulose suspensions by birefringence imaging

Background:

In real-life applications, suspensions face complex deformation field. Usually, one needs several different instruments and setups to know more how the flow field affects the nanostructural arrangements. Rheological measurements can provide an insight into the properties of the suspensions, but by rheology alone we cannot gain structural information of the materials in question.

Corona et al [1] developed a Fluidic Four Roll Mill (FForm) device that allowed them to study various materials in complex flow fields by polarized light microscopy and small-angle neutron scattering. This setup allows us to study the structural changes in the whole flow field presented by the device and by changing the flow rates one can access a wide range of flow types for moderate strain rates within the same device.

In a previous Master Thesis project, a scaled down FFoRM setup was used to study materials in flow by a birefringence imaging system to study the effect of strain rates, flow types and the concentration on the behavior of suspensions.

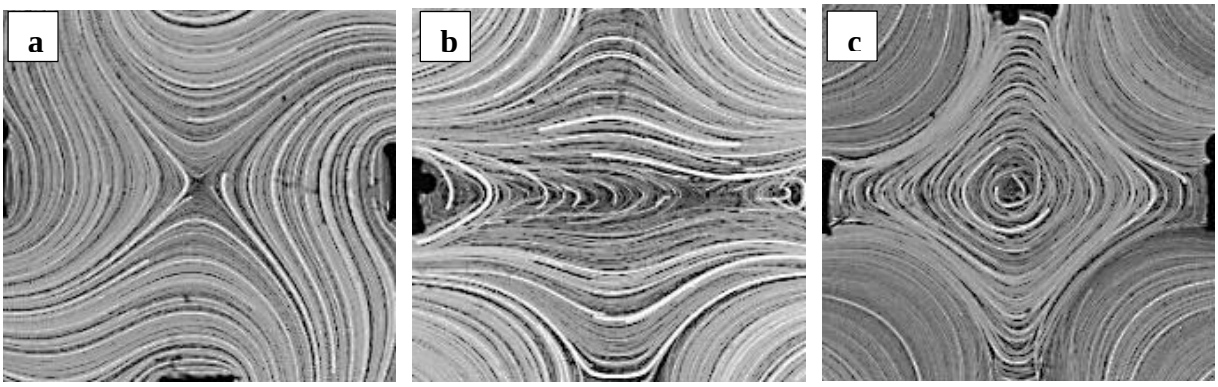

Figure 1. Streaklines for extensional (a), shear (b) and rotational (c) flows [1].

Project plan:

The project can be adjusted to the student's interest in terms of experimental/computational work. We are prepared to take health and safety regulation/recommendations into account.

The experiment-focused project will encompass a literature study, setup optimization, birefringence imaging and additional sample characterization experiments as well as automized data analysis by Matlab or Python.

The computation-focused project will contain a literature study, small-amount of birefringence imaging experiments with in-depth analysis by Matlab or Python on already acquired data. Interest in optics is recommended for this part. According to the preference of the student, most of this work can be conducted from home.

The project will be embedded in the Liebi research groupin the Division of Material Physics. For question, contact Barbara Berke (barbara.berke@chalmers.se) or Marianne Liebi (marianne.liebi@chalmers.se).

[1] P.T. Corona, N. Ruocco, K.M. Weigandt, L.G. Leal, M.E. Helgeson, Probing flow-induced nanostructure of complex fluids in arbitrary 2D flows using a fluidic four-roll mill (FFoRM), (2018) 1–18. doi:10.1038/s41598-018-33514-8.