The Flow of Nano-Crystals – Into the Woods

Motivation

In the past years Nano Cellulose Fibrils (NCFs) and Crystals (NCCs) have become sustainable alternatives to synthetic polymers in applications such as membranes in water purification and flow-modifiers for 3D printing amongst many others[1]. NCFs and NCCs are extracted from wood, bushes and even from specialized bacteria through various chemical processes. The underlying molecular structure is that of poly-saccharide chains that, after extraction, self-assemble into fibrils of a hundreds of nanometer thickness and many lengths in the range of milimeter. This very large aspect ratio gives rise to them acting as very strong gel-former and flow-modifier. However, the precise physical behaviour leading to their unusual effect on the flow of simple liquids is still largely unexplored.

Your Project

In this project the student will explore the rheology of aqueous suspensions of NCFs and NCCs as function of their charging state at different pH and the overall ionic strength of the solutions. The systems temperature dependence will be investigated as well, as they often display temperature-sensitive aggregation. The student will learn about mechanical, macroscopic rheology (study of how fluids flow) and light-scattering based micro-rheology[2]. In the extended project the student will also explore the production of bacterial NCFs.

Requirements

would like an applicant who is keen on experimental work and understanding the background theory in polymer physics.

Other aspects

The experimental study will be supervised by the Professor Eiser, an expert in the rheology of self-assembling DNA systems. Professor Kristin Syverud is an expert Nano Cellulose Research for sustainable materials at the Chemical Engineering Department and Research Manager of RISE/PFI.

Contact person

EiserEiser (erika.eiser@ntnu.no), Polelab and Dept. Physics, NTNU.

[1] M. Kobayashi, Y. Sato, T. Sugimoto 'Effect of pH and electrolyte concentration on sol–gel state of semi-dilute aqueous cellulose nanofiber suspension: an interpretation based on angle-dependent DLVO theory' *Colloid and Polymer Sci.* **300**, 953 (2022)

[2] Z. Xing, A.Caciagli, T. Cao, I. Stoev, M. Zupkauskas, T. O'Neill, T. Wenzel, R. Lamboll, D. Liu, E. Eiser 'Microrheology of DNA-Hydrogels' *PNAS* **115** (32), 8137 (2018)