Title: Flow properties of soft spheres probed by rheo-SANS

A fine control of the flow properties of soft material is pivotal for their use in many applications, e.g., vaccine and drug delivery, paints and smart-coating, yield-stress material for 3D printing and cell-growth or tissue engineering. Furthermore, there are many fundamental questions still missing a clear answer regarding the role of particle softness on the ordering, phase separation, and shear-banding of soft material under flow.

During the **3.5 years of this project** (1.5 financed by **RWTH Aachen**, 2 financed by **ILL**), the PhD student will use pNIPAM-based microgels as a model system for soft spheres to investigate the interplay between the ordering and resulting macroscopic properties of the suspensions under flow, and the compressibility of individual particles. These particles have been extensively used to study the impact of softness on the phase behaviour and flow properties of soft materials. We plan to **combine rheological experiments with small-angle neutron and x-ray scattering measurements**. The use of the 1,2-shear cells available only on D22 at the ILL is fundamental. This cell allows us to collect fundamental information in the flow direction that is the most sensitive to deformations and bending of the samples. These data will be complemented by SANS and SAXS measurements using a conventional rheometer to have the full 3D characterization of the structure under flow. The information on the individual particle response under flow will be obtained using SANS with contrast variation.

The main objectives of this project are: (i) Probe the shape and architecture of individual microgels under flow; (ii) characterize the structure the microgels form under flow; (iii) probe the structure of the suspension with time and spatial resolution to clarify the nature of the band formation and phase separation observed under shear. Due to lack of investigations in the 1,2-plane, there is a deficit of universal models to describe the effects of structuring, e.g., shear banding or deformation, on the macroscopic viscoelastic properties of soft materials. The use a well-defined model system will allow us to understand the fundamental principles ruling the flow of soft spheres. By precisely quantifying the softness using parameters we previously defined, we also plan to compare our results with other experiments on different soft colloids such as single chain nanoparticle, polymer rings, star- like polymers, antibodies, and bio-compatible nanoparticles to identify common trends. Furthermore, our findings might be of interest for a better understanding of materials that undergo shear during application, for example paints and drug delivery systems

The total duration of the project will be 3.5 years. The PhD student **will start the project (1 year) in Scotti's group (RWTH Aachen, Germany)** where the synthesis and characterization of the microgels will be performed. In this period the student will also be introduced to the basics of rheology and the first rheological characterization will be performed. During the **following 2 years** the PhD student will be located **at ILL (Grenoble, France)** focusing on rheo-scattering experiments (with short visits to the IPC). For the **final 6 months** of the project the PhD student will **return to Aachen** to finalise the writing of the thesis and the PhD defence.

How to apply: Send an email to Andrea Scotti (scotti@pc.rwth-aachen.de) and Lionel Porcar (porcar@ill.fr) with the subject "SCM-2023-15-YourName". Attach a CV, a brief motivation letter and the contact person for a reference. You are also welcome to contact Andrea Scotti if you have any questions. The position will stay open until filled. The ideal starting date is October 2023.

Additional details about the specific conditions for the PhD and the application procedure, please consult the following link:

https://www.ill.eu/careers/all-our-vacancies/phd-recruitment/open-phd-positions