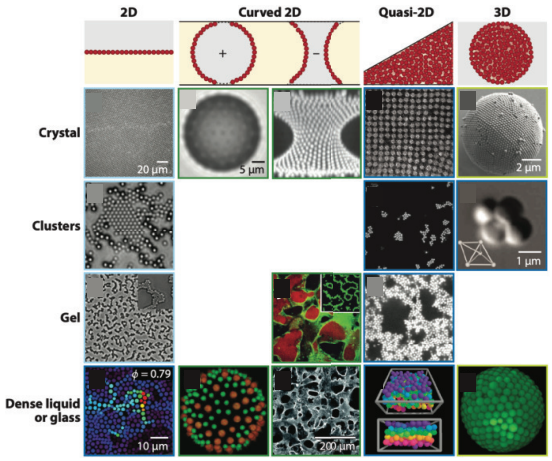
# Can we use coffee-stains for the assembly of designer materials?

Udo Sen

Physical Chemistry and Soft Matter (PCC)

The assembly of colloidal particles at fluid-fluid interfaces has been the subject of intense research, and represents a unique method for bottom-up designing of materials with highly-controllable microstructures. The fundamental mechanism driving such assembly is essentially the same as the one that results in stains appearing from spilled coffee: when a liquid containing dispersing microparticles (e.g. coffee) dries, it leaves behind the particles in a highly-ordered structure. This process can be repeated several times in a controlled manner to obtain designer materials.




*Diverse self-assembled designer materials obtained from colloidal self-assembly*

The final microstructure of the assembled material can be tuned in a number of ways: by changing the solvent, the type of particles, their size, shape, concentration, and surface chemistry. A complex interplay of all these parameters determines the microstructure of the final material, which further dictates its applicability. **In this project, we will study how the same colloidal particles can be controllably-assembled into distinctly different structures by tuning one or more of these control parameters.**

## Objectives

- **Characterize the drying of liquids containing colloidal particles**
- **Understand how colloidal particles self-assemble when the liquid dries out**
- **Relate the different tuning parameters to the final microstructure of the assembled material**

This interdisciplinary technique, while addressing a highly relevant societal challenge, will also let you gain hands-on experience in state-of-the-art experimental techniques such as:

- **Microfluidic systems**
- **High-speed optical and fluorescence microscopy**
- **Particle tracking and flow visualization**
- **Raman spectroscopy and scanning electron microscopy**
- **Physical modeling**

This thesis project offers a unique blend of experimental innovation and technological exploration, making it an exciting opportunity for students passionate about soft matter, physical chemistry, food science, or food technology. By participating in this project, students will:

- Gain hands-on experience with advanced experimental techniques
- Collaborate in a multidisciplinary research environment
- Contribute to a pressing technological challenge

Are you ready to embark on a journey of discovery, innovation, and impact? Then this project awaits your curiosity and drive. **Together, let's explore the unseen world of colloidal self-assembly, and reveal how we can use it to develop materials for the future.**