PhD position in ***Rheo-physics of fat crystal networks: formation and aging***

Context: The fundamental project CONCIOUS (Controlling enhanced soft matter microstructures via the fundamental understanding of formation time scale competition), funded by KU Leuven is an interdisciplinary project where several professors of the Soft Matter, Rheology and Technology division (SMaRT) join forces to tackle fundamental questions in soft matter and their application in various sectors, here in particular the food science and engineering sector.

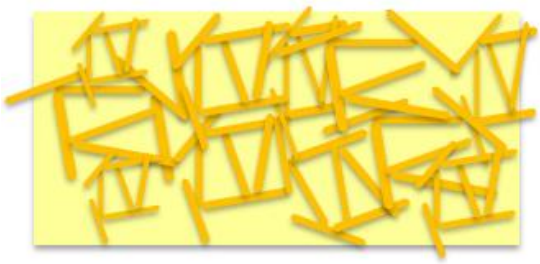
Hiring institution: KU Leuven (KUL), Belgium, with enrolment in a doctoral programme.
Hosting lab and working environment: The Soft Matter, Rheology and Technology (SMaRT) division labs https://cit.kuleuven.be/smart, are equipped with cutting edge soft matter techniques, which will be taken advantage of in this research: shear and extensional rheometers combined with additional spectroscopic techniques like Raman and dielectric spectroscopy, rheo-confocal microscopy and rheo-optical devices allowing to visualize in-situ dynamics. The lab has expertise in the areas of colloidal phenomena like aggregation, polymer dynamics and crystallization as well as interfaces in emulsions and foams.

Supervision: main supervisors (KUL) will be Prof. Deniz Z. Gunes (Deniz Gunes — SMaRT) and Prof. Ruth Cardinaels (Ruth Cardinaels — SMaRT) – KU Leuven.

Background and objectives:

Fat crystal networks are everywhere in food: the structure building the texture of fat containing products is often critical for their mouthfeel, but often also for their stability and processability. Think of all the layered dough in culinary or pastry, but also all the dairy and plant-based dairy alternatives, which now need both effective healthy structuring approaches. Reduction of saturated fatty acids (SFA) in our diets is certainly one of the current global health needs, which obliges us to better understand the fundamental links between the microstructure of fat crystal networks, and their rheology. Fat crystal networks are determined by fat type, temperature profile, age, and process, in a way allowing industry to manage well to deliver specifically textured products. Yet, there is a huge scientific gap regarding the **link between rheology, microstructure and crystal polymorphism**, as **resulting from a certain formulation and process**, which is the subject of this PhD. Due to the **presence of highly metastable structures** (having lifetimes from the minute scale to months), the **interplay between heat and mass transfer** couples with the complex polymorphism. That results in highly interesting **dynamics of long-term evolution** of the molecular packing, microstructure and rheology, which we want to understand here.

Using "model systems" mainly, e.g. a monoglyceride in oil, the goal will be to try and uncover that link, taking advantage of the following techniques: **Differential Scanning Calorimetry (DSC) / Microcalorimetry, X-ray scattering (including at a synchrotron), Rheology, Polarized microscopy, rheo-optics, rheo-dielectric measurements.**



Schematic representation of a fat crystal network.

Relevant literature:
a) Structure and Properties of Fat Crystal Networks. Alejandro G. Marangoni, Leendert H. Wesdorp. CRC press, ISBN 9781032652207.
b) Aging and Metastability of Monoglycerides in Hydrophobic Solutions. Chen and Terentjev. Langmuir, 25(12), 6717–6724 (2009), DOI: 10.1021/la9002065

Expected results:

- Experimental description of key parameters and mechanisms involved during the initial fat crystal network formation of the model system.
- Linking the polymorphic dynamics, microstructure and rheology quantitatively during fat network formation
- Mechanistic description of the phenomena involved in the polymorphic and microstructural aging of the network, linking to consequences in rheology
- A multi-technique description of the phenomena, and generalisation to further systems based on the model system studied.

Type of recruitment: Full-time exclusive employment contract including full social security coverage

Foreseen start date: 1 April – 1 July 2025

Duration: 48 months

Hours per week: 38 hrs

Application procedure: via the KU Leuven application portal, using the following link: https://www.kuleuven.be/personeel/jobsite/jobs/60402901?lang=en *Please check the eligibility and mobility criteria further in this document.*

Application deadline: 28 February 2025

Contact for more info: Deniz Z. Gunes, deniz.gunes@kuleuven.be

Selection criteria (cf. Guide for applicants MSCA DN 2023)

Eligibility rule: All researchers recruited must be Doctoral Candidate i.e not already in possession of a doctoral degree at the date of the recruitment. Researchers who have successfully defended their doctoral thesis but who have not yet formally been awarded the doctoral degree will not be considered eligible.

In addition to the respect of the eligibility and mobility rule, the selection criteria will be scientific excellence, motivation and suitability for the job. Special attention will be paid to gender and equal opportunity issues. The ESM PhD positions are open to all candidates irrespective of age, gender, race, disability, religion or ethnic background.

Candidates profile

- MSc or equivalent in Chemical Engineering / Material Science / Soft Matter Physics / Food Physics with a solid training in the material science /physics / transport phenomena aspects

i.e. with an ability to read and use the base theoretical concepts, and apply them to a real, complex case

- Strong scientific motivation to find the key to long-standing questions; dedication to research and career goal to work in structural engineering of materials (e.g. food materials).
- Appreciation for highly rigorous work, as well as taste for challenging the current status quo of understanding in a field.
- Proficiency in English, good communication skill and social competence

How to apply ?

Please **send your applications written in English via the following link: Apply at KU Leuven**

, which must include: • An up-to-date CV, detailing work experience and research and academic achievements • A cover letter exposing the candidate motivation for the project • At least two reference letters from a (former) supervisor, professor or a manager with contact information. • Scanned copy of the degree (usually the master's degree) which would formally entitle the candidate to embark on a doctorate. If the degree has not been obtained yet, the applicant will have to ensure that the date of graduation will be earlier than the start date of the ESR contract. • Transcript of records (applicant's ranking and marks) for both Bachelor degree and Master degree. In case the applicant has not obtained their Master degree yet, a copy of the most up to-date Master grades should be provided • A copy of an identity document.

In addition, as suitable candidate:

- You are highly motivated by the topic proposed

- You have base knowledge and possibly some hands-on experience in at least one of the following areas: rheology, colloids, food dispersions, crystallization

- You have excellent analytical skills and the taste to go in the depth of scientific questions

- You like to be creative and follow original research paths in a rigorous manner.

- You are able to report your progress in an accurate and timely fashion.

- You have excellent communication skills, with fluency in both written and spoken English.

- You are open for collaboration with the other team members, and like interdisciplinary work

More on this offer:

- Full-time PhD position for four years with a competitive salary and additional benefits such as health insurance, access to university sports facilities, etc.

- International work environment and possibility to present your work on international conferences

- Your research will be embedded in a world-renowned research group consisting of 7 faculty members active in the area of soft matter rheology, technology, and food science

- A state-of-the-art experimental infrastructure

- A full-time employment for four years, with an intermediate evaluation after one year.

To support you during your PhD and to prepare you for the rest of your career, you will participate in the Arenberg Doctoral School doctoral training program (Doctoral Training – ArenbergDoctoral School (kuleuven.be)).

More on the SMaRT division

The aim of the Soft Matter, Rheology and Technology (SMaRT - https://cit.kuleuven.be/smart) division is to foster and conduct research on soft matter and the rheology of complex fluids on a fundamental level as well as their 3 application to technical processes, including for food materials. Our research aims at designing methodologies for intelligent process or product (formulation) design using so-called "complex fluids" or "soft matter", including for food materials considered with a soft matter approach. The aim of the SMaRT section is thus to study the fundamental dependence of the molecular and microstructure of such systems to their complex phenomena. To achieve our goals, the division SMaRT has a state-of-the-art rheological infrastructure: to give it includes traditional (both rotational and capillary) rheometers. We also have a range of instruments to measure the interfacial rheology and the dynamics of structures at an interface. A wide range of setups to characterize the flow-induced microstructure, including microscopic techniques, light scattering and rheo-optical methods are available. They will be complemented with tools to study the dynamic structure of foams in depth.