NEWSLETTER

No. 3 **February 2026**

Funded by the European Union

CoCoGel (*Controlling Colloidal Gels for Novel Sustainable Materials*) is an MSCA Doctoral Network—Industrial Doctorate project which is composed of 15 Doctoral Candidates. Thanks to their complementary approaches, CoCoGel aims at developing the next generation of colloidal gel-based materials by understanding how these out-of-equilibrium microstructures respond to internal and external stimuli.

This 3rd edition is not only the occasion of exploring the research of colloidal-gel based materials. It's a special moment to highlight that CoCoGel is also a human adventure. CoCoGel is deeply engaged towards a more inclusive and accessible science, both oriented towards the scientific community (our organized events are free of charge) but also towards the non-scientific audience in order to inspire people to pursue careers in science.

Today's newsletter presents the network's main events and our upcoming deliverables, and 3 DCs are presenting their research activity. We will discover the latest research on anisotropic particles, application of ultrasound in the process of tuning gels, but also the rheology of catalytic inks.

Upcoming Event

Industrial training

CoCoGel x Biomac-BP

The Netherlands

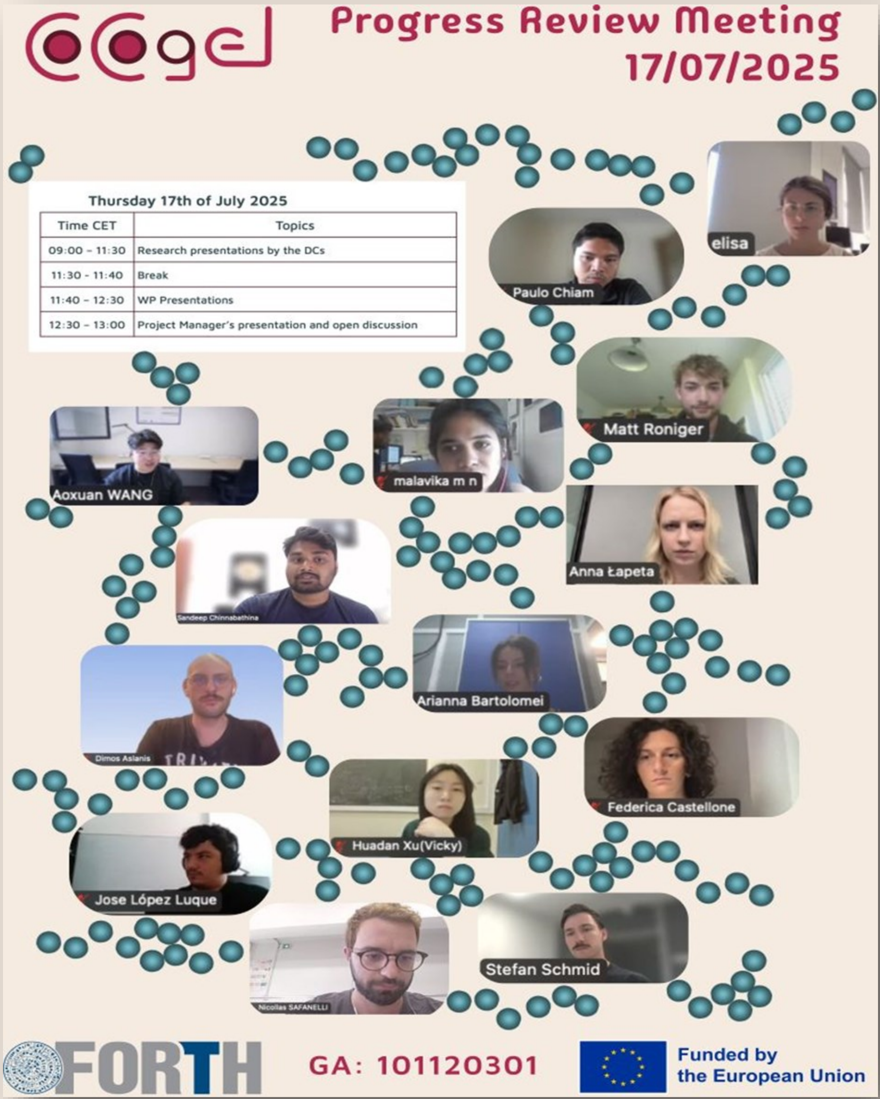
30/03-02/04/2025

Project Review Meeting — online

On Thursday, July 17, 2025, members of the CoCoGel consortium came together for a Project Review Meeting to share updates and plan the next steps in their collaborative research.

Doctoral Candidates, with the support of their supervisors, presented the progress of their research and introduced exciting new areas they will be exploring in the near future. The meeting provided an opportunity for valuable feedback, helping to improve each research project and encourage stronger teamwork across the group.

The consortium also discussed the schedule for upcoming goals and events, and reviewed key technical and administrative tasks to ensure the project continues to move forward efficiently and successfully.



Summer School on Computational Methods

From 25th to 27th of September 2025, in partnership with the European research program, FORGreenSoft, CoCoGel co-organized its Summer School on Computational Methods at IESL-FORTH.

This event was an not only an intensive program on Computational Matter applied to Soft Matter, but it was also a hub for master and doctoral students to exchange on their research topics, create or deepen their collaborations.

The Summer School took the form of lectures and hands-on sessions covering:

- Multi-scale Modeling & DPD Simulations of Soft Matter
- Mesoscopic Modeling with Multi-particle Collision & Stokesian Dynamics
- Data-driven Modeling and AI/ML in Material Science

We are warmly thanking our tutors Anastassia Rissanou (TPCI NHRF), Oleksandra Kukharenko (MPIP Mainz), Tyler Shendruk (University of Edinburgh), Joost de Graaf (University of Utrecht) and Safa Jamali (Northeastern University) for their contributions!

Summer School on Computational Methods at FORTH—Group photo

European Researchers Night 2025

On 26th of September 2025, FORTH organized the European Researchers' Night (ERN). The aim the event is to promote the value of science, inform about the scope and the latest research progress, but also to create new vocations for research.

It's in this context that our Doctoral Candidates took part in this latest edition of the ERN. They engaged with the public thanks to hands-on experiments:

1. The Magnetorheological Effect: A demonstration using magnetorheological fluids, where participants observed the solidification of the sample under a magnetic field
2. Cornstarch Magic: Showing how a liquid can suddenly behave like a solid, as visitors explored the shear-thickening effect of cornstarch solutions at different concentrations
3. Making the Unflowable Flow: A unique challenge, where a paste that could not flow through a funnel was transformed into a flowing substance.

CoCoGel Doctoral Candidates engaging with the public at the European Researchers Night' 2025 at FORTH

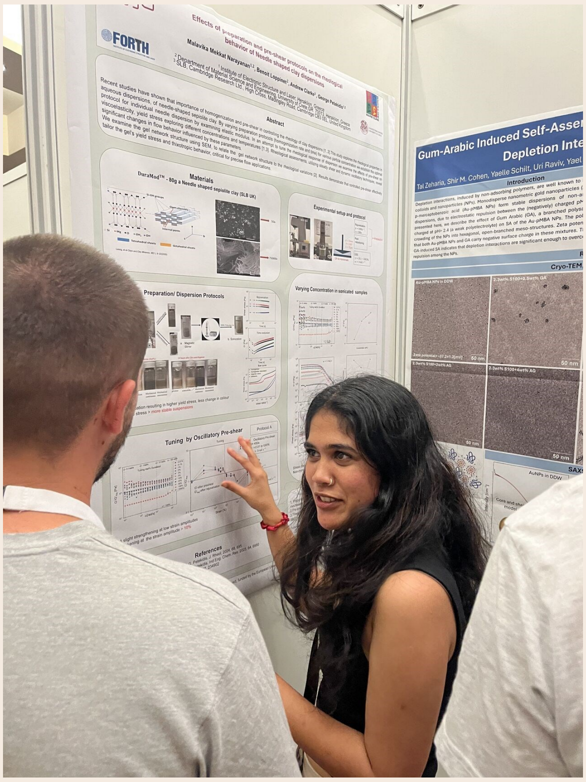
International Soft Matter Conference 2025

The International Soft Matter Conference 2025, held in Chania from September 29th to October 3rd, brought together the soft matter community from all-around the world for an inspiring week of science. This 9th edition of the conference, co-organized by CoCoGel, was focused on 9 thematic in order to provide a broad range of perspectives discussing the latest cutting-edge research.

Our Doctoral Candidates were, of course, fully invested on this event: expanding their networks, exploring new scientific perspectives, and sharing their work through engaging poster presentations. These sessions provided a fantastic opportunity to exchange ideas with other PhD researchers and senior scientists alike—defending their findings, sparking discussions, and building new connections across the soft matter world.

At CoCoGel, we are proud of supporting events that not only push the boundaries of scientific discovery but also foster culture of collaboration and ethical research.

Dimos Aslanis (DC7) - Poster presentation at the ISMC 2025



Malavika Mekkat Narayanan (DC2) - Poster presentation at the ISMC 2025

Soft Skills Workshop

From 8th to 10th of December 2025, CoCoGel brought together its Doctoral Candidates at the University of Edinburgh for a three-day Soft Skills Workshop. At CoCoGel, we are convinced that strong communication and interpersonal skills are key to developing the next generation of researchers.

The program offered a dynamic lineup of lectures and interactive sessions, featuring:

- Hands-on Writing—Marialuisa Aliotta (UEDIN)
- How (not) Give a Talk—Wilson Poon (UEDIN)
- How to Give Feedback—Tyler Shendruk (UEDIN)
- Working as an Industrial Soft Matter Scientist—Thomas Curwen (Mondelez International)
- Industrial Consultancy and Managing Industrial-Academic Partnership—Daniel Hodgson (UEDIN, Complex Fluids Partnership)
- Industrial R&D: Bridging the Academic-Industrial Divide—David J. Moore (UEDIN)

CoCoGel addresses a heartfelt thank you to all tutors, participants and to the dedicated local organizing team.

CoCoGel group photo at the University of Edinburgh—Soft Skills Workshop

Malavika Mekkat Narayanan

Anisotropic particle gels under external and internal stimuli

Applications in industrial systems

FORTH FOUNDATION FOR RESEARCH AND TECHNOLOGY - HELLAS

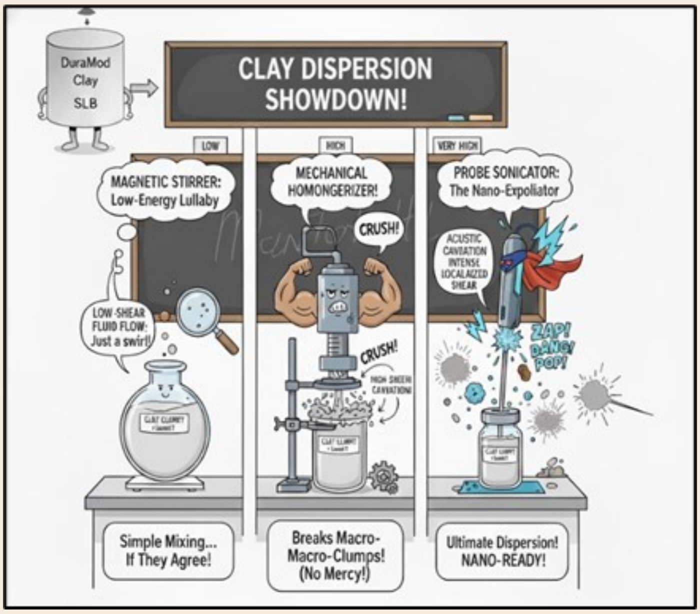
Think of a gel not as a simple substance, but as a hidden, microscopic web. Now, imagine that web is built from countless tiny particles that aren't perfectly round. Their odd, needle-like shapes allow them to link up, catch, and hold onto one another, forming a surprisingly strong and flexible 3D structure. What's fascinating is that we can completely change this gel's properties making it softer, firmer, or more elastic just by tweaking a few simple things. Adjusting how many particles we add, the way we mix them, or even how vigorously we stir can completely reshape the gel from the inside out. It's interesting how small changes on a microscopic level can lead to huge differences in the final product.

What's my PhD about?

My research is all about these gels made from tiny, needle-shaped particles, like the kind found in certain clays or silica rods. They're used all over in industry, for things like viscosifiers in drilling fluids. My job is to figure out how different preparation steps like how the material is mixed, processed, or treated affect the final gel's thickness, how it flows, and the secret structure it forms inside.

Right now, I'm working with a natural clay called sepiolite, which is made of long, thin mineral fibers. When you mix it with water in just the right way, it forms a gel. But getting that gel to behave consistently is tricky. Sepiolite fibers have a natural tendency to stick together, but there are also weaker forces trying to push them apart. Left on its own, this "unsticking" process takes forever. To make a good, uniform gel, we need a powerful and controlled way to break up those initial clumps and help the fibers spread out evenly in the water.

Specifically, I'm looking at how different mixing methods, the amount of clay I use, and the stress I apply affect the gel's stiffness (its modulus), the force needed to make it flow (its yield stress), and what that final microscopic web actually looks like.



Title: *AI generated image of preparation protocols*

What are the challenges?

These materials have a mind of their own. Clay particles in water are constantly shifting and reorganizing themselves, meaning a sample I measure now might have different properties in an hour. This natural unpredictability makes it difficult to get reliable measurements or predict exactly how a gel will behave.

What's the goal?

Ultimately, I want to create a perfectly stable, evenly mixed clay suspension. From there, the goal is to develop a reliable "recipe book" for adjusting and fine-tuning its properties on demand.

This research, focused on a commercial suspension called Duramod, isn't just for industrial drilling fluids. The principles we're learning here about proper mixing, pre-treatment, and stability apply to so many things we use every single day.

This knowledge can improve the consistency and quality of everything from food and drinks to cosmetics, paints, and pharmaceuticals by preventing ingredients from separating, clumping, or feeling gritty. Figuring out how to control these tiny particles can make the products we all use safer, more reliable, and of better quality.

Lennard Schulte

Tuning colloidal gels with ultrasound: application to gel flow and structuration

Think about making bread at home. When you knead dough, you're not just mixing ingredients; you're applying force that changes its structure. At first, the dough is sticky and shapeless, but as you keep kneading, it becomes smooth and elastic. This transformation happens because of shear forces, the sliding motion between layers of material. Shear is everywhere in food preparation, from stirring sauces to pumping chocolate through pipes in a factory. It's a force that quietly shapes the texture of what we eat.

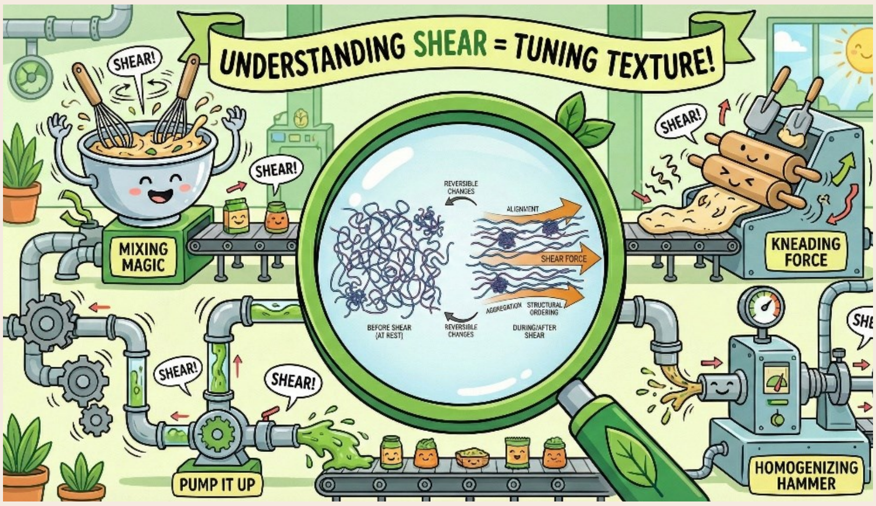


Figure 1: AI-generated illustration showing that shear forces are present in many food processing steps, from mixing to pumping, and play a key role in shaping texture. By understanding how these forces affect plant-based biopolymer gels, we can harness shear to fine-tune texture and mouthfeel, paving the way for cleaner-label, more sustainable foods.

Just like kneading changes dough, shear changes the structure of foods and that's where my research begins. I study shear-induced changes in plant-based biopolymer systems. Biopolymers, such as proteins and fibre, are the natural building blocks of food. They are abundant in plants and essential for creating sustainable diets. One example is cellulose, the most common biopolymer on Earth. In plants, cellulose chains are bundled into tiny structures called cellulose microfibrils, which give cell walls their strength. When we process plant material, these bundles often remain locked inside dense cell wall fragments, making it hard to achieve the textures we want in food.

In one project, I worked with insoluble dietary fibre, a byproduct of juice production. Before processing, the structure under a microscope looks like solid chunks of cell wall material, dense and rigid. After passing the dispersion through a homogenizer, which pushes it at high speed through an extremely narrow channel, those bundles seem to explode forming fluffy flocs. The intense shear forces overcome the strong attractions between cellulose microfibrils, breaking apart the fragments and dispersing the microfibrils and their smaller bundles throughout the liquid. Once free, these microfibrils still attract each other, but now they form a more open, flexible network that spans the entire sample. This network gives the material gel-like properties: it holds its shape and feels thicker, even though it's mostly water. By adjusting how fast we push the dispersion through the channel, we change the shear forces acting on the sample, and with that, we can tune how firm and elastic the gel feels. Elasticity gives food its personality, whether it feels luxuriously smooth and creamy, stands proudly on a spoon, or offers that gentle, satisfying bounce when you take a bite.

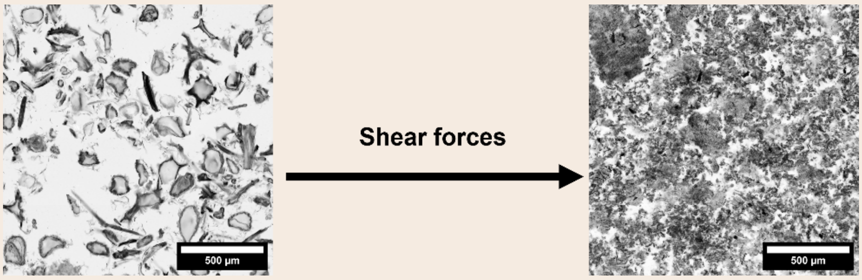


Figure 2: Effect of pushing dispersions of insoluble dietary fibre through the homogenizer on the structure under the microscope (left: microstructure before homogenization, right: microstructure after homogenization).

My research aims to understand shear induced changes in plant-based food material so the forces already present in food processing can be used to shape texture in a predictable way. This research paves the way to design plant-based foods that are not only sustainable but also enjoyable to eat. And by turning side streams containing insoluble dietary fiber into valuable ingredients, we move toward a food system that is better for people and the planet.

Paulo Chiam

Rheology and microstructure of model catalytic inks under simple and complex shear

Why do toothpastes stand on toothbrushes, flow readily when squeezed, and remain stable during travel and storage? Every day, billions of people worldwide use toothpaste without realizing that each squeeze contains a highly complex system. My research focuses on the underlying interactions and microstructures that cause toothpaste to behave the way it does, which is primarily controlled by abrasives such as small silica particles suspended in a polymer solution of water, sorbitol, and carboxymethyl cellulose (CMC). Each of these components interact with one another via various physical forces, determining whether the paste behaves as a soft solid, a flowing liquid, or somewhere in the middle.

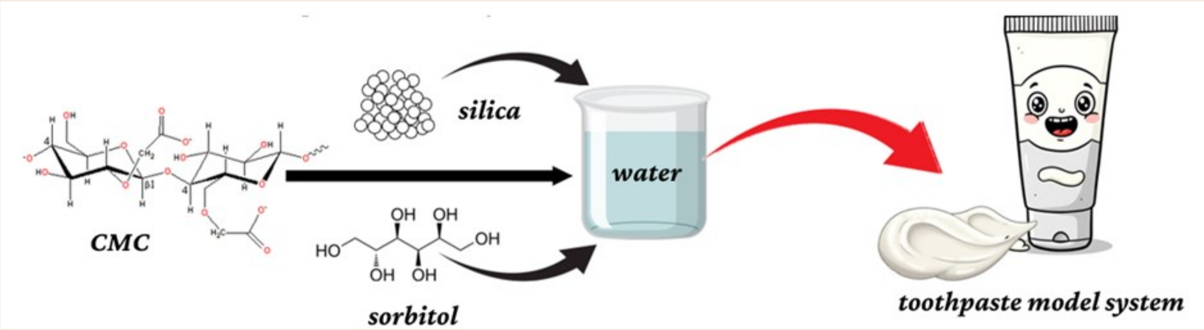


Figure 1. Main components of a model suspension for toothpastes

Suspensions of non-Brownian particles, such as 3-micron silica, in a non-Newtonian polymer solution have not been thoroughly studied, and the presence of additional forces in this system, such as friction, adhesion, and depletion interactions, among others, presents a new set of interactions when compared to classical electrostatic repulsion and van der Waals forces. Understanding how all of these factors interact to stabilize or destabilize microstructures is critical for understanding how toothpaste behaves under different conditions.

My project’s objective is to design and study model colloidal suspensions that imitate the complexity of products like toothpaste. One component of the research involves looking into how shear and temperature changes, from laboratory/factory formulation and filling to home storage, affect the small network of particles. For example, during high-shear processing, the structure may entirely collapse before gradually reconstructing. Application of stress weakens the gel structure, which then recovers within seconds. Capturing these fast and delayed reconstruction processes demands the development of new experimental techniques capable of measuring microstructural changes in real time.

Another objective of this project is to determine how different formulation parameters such as particle volume fraction, size and shape, and polymer concentration affect the stability and recovery of these structures. The long-term goal is a predictive framework linking microstructure, flow behavior, and performance. This will enable toothpastes that are more stable across temperatures and transport, deliver superior cleaning and polishing and provide better texture. From an industrial perspective, optimized formulations reduce production costs by minimizing waste, improving manufacturing efficiency (e.g., easier pumping and filling), and extending shelf life. For consumers, better stability means consistent performance from tube to tube, effective polishing, reduced sensitivity through controlled abrasion, and an enjoyable brushing experience that encourages regular use. Ultimately, these advances in colloidal science will deliver tangible benefits: safer, more effective, and more sustainable everyday products.

UPCOMING DELIVERABLES AND MILESTONES

January to June 2026

Deliverables	Lead Beneficiary	Date
D6.4 Report on soft skills seminar	CNRS	28/02/2026
D2.1 Effect of Shear on Isotropic Colloidal Gels	FORTH	31/03/2026
D4.1 Generalise Rheo-Acoustic Framework to Colloidal Gels	CNRS	30/06/2026
D4.3 Physical Mechanisms for Inclusion-Based Gel Restructuring	TU Delft	30/06/2026
D4.6 Physical Mechanisms for Inclusion-Based Gel Restructuring	TU Delft	30/06/2026
D5.4 Magnetic-Controlled Aggregation for Biomedicine	NanoGetic	30/06/2026
D2.2 Application of Shear-Insight for energy materials	SUNLIGHT	30/09/2026

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