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Micro and macro rheology of colloidal gels with embedded thermoresponsive particles

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Introduction

Colloidal gels are ubiquitous materials found in applications such as concrete, batteries, cosmetics, paints or food products. They consist of colloidal particles from 100nm to 1µm interacting by attractive forces, leading to the formation of a percolated network of clusters of particles. Their mechanical properties of colloidal gels are closely linked to the structure of this network.

Flow properties of colloidal gels, are probed at the macro-scale with rheology but do not give direct information about the clusters. Hence, micro-scale approaches using micro-rheology [1] and rheo-confocal setups [2] had been developed in order to understand the mechanical properties at the cluster or the particle level and link it to the macroscopic mechanical behavior of the material. More recently, work from Szakasits *et al.* [3] showed that active particles in a colloidal gel lowers the bonding energy between particles and globally weakens the gel.

The goal of this project is to further push this idea by integrating in a colloidal gel thermoresponsive particles which would deform internally the structure of the percolated network in a more controlled way. The project will be separated in two phases:

1) Synthesis of thermoresponsive particles which can provide a good range of deformations and rate of deformations. Previous work on the synthesis of cubic particles has already been carried

2) Integration of the particles to a colloidal gel network and study the local deformation by particle tracking along with global mechanical behavior of the gel through rheology

Methods used in the project

Particle synthesis

Rheology

Confocal microscopy

References

[1] Furst, Current Opinion in Colloid & Interface Science, **10**, *1-2* (2005)
[2] Colombo *et al.*, Korea-Australia Rheology Journal, **31**, *229* (2019)
[3] Szakasits *et al.*, Soft Matter, **15**, *8012* (2019)