



PhD Position : **Auto-organization and mechanical properties of self-healing composite gels**

Location : **3SR Lab**, CoMHet team, Grenoble, France
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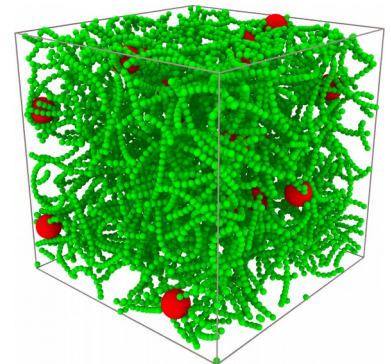
Collaboration : **CERMAV**, SMP team, Grenoble, France
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Project summary

New generation of self-healing hydrogels composed of nanoparticles incorporated into a 3D bio-polymeric matrix (see figure) are revolutionizing medical implants technologies. However, the microscopic mechanisms controlling their self-assembly and at the origin of their mechanical properties remains poorly understood, which hinders a technological breakthrough.

This PhD research program aims at lifting this lock by combining complementary expertise of 2 labs in Grenoble: (i) cutting-edge computational techniques through large scale coarse-grained molecular dynamics simulations and experimental investigations of the mechanical behavior of heterogeneous materials at 3SR lab; (ii) physico-chemical formulation as well as structural characterization of hydrogels at CERMAV using NMR spectroscopy, Dynamic Light Scattering and Transmission electron microscopy. The goal of the PhD is to elucidate:

- How does the kinetics of the self-assembly sculpt the complex spatial organization of the micro-structure for composite gels ?
- What are the microscopic mechanisms governing their toughening under mechanical loads ?
- What are the impacts of the NPs spatio-temporal organization and polymers-nanoparticle bond dynamics on their self-healing abilities ?



Numerical simulation of a composite gel, nanoparticles in red and polymers in green

Location and practical aspects

The successful candidate will benefit from the international outreach of the University of Grenoble Alpes. The core of the thesis will be on computational modeling at **laboratory Soils, Solids, Structures, Risks (3SR, www.3sr-grenoble.fr)** in the “CoMHet” team gathering renowned experts in the physics and mechanics of divided media, soft architected and bio-mimetic materials. In parallel, the PhD student will also contribute to experiments at **CERMAV**, a fundamental research CNRS laboratory which has internationally recognized expertise in the controlled chemical modification of natural carbohydrate polymers, their assembly in functional materials and their physico-chemical characterizations.

- Requests for thesis grant funding submitted and expertise in progress.
- Starting date: November 2021 for a period of 3 years.

Profile and required skills :

Candidates with academic backgrounds in statistical physics, soft matter or physico-chemistry are expected. Specific skills in numerical modeling will be strongly appreciated. Additional knowledge in polymer physics and colloidal materials will be interestingly examined.

Interested candidates should send their **CV**, a **cover letter** and **official transcripts of the last two years** before **2021, May the 21st** to Mehdi Bouzid, mehdi.bouzid@3sr-grenoble.fr.