



## 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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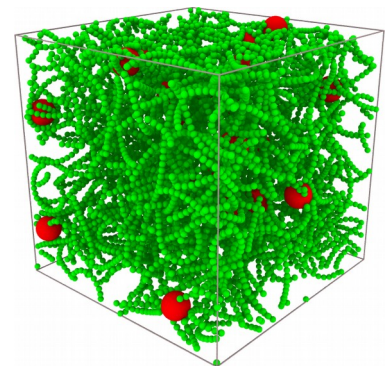
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### Project summary

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](http://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](mailto:mehdi.bouzid@3sr-grenoble.fr).