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

Location: **3SR Lab, CoMHet team, Grenoble, France**

mehdi.bouzid@3sr-grenoble.fr, lucie.bailly@3sr-grenoble.fr, laurent.orgeas@3sr-grenoble.fr

Collaboration: **CERMAV, SMP team, Grenoble, France**
rachel.auzely@cermav.cnrs.fr, raphael.michel@cermav.cnrs.fr

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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?

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**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 architectured 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.

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**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.