

PhD position starting in the autumn of 2025

Center for Materials Forming (CEMEF), MINES Paris - PSL University
Soft Matter Sciences and Engineering Laboratory (SIMM), ESPCI - PSL University

Magnetic aerogel granular materials for soft robots

Magnetic soft robots are capable of tether-free, instantaneous and “programmable” shape change in a magnetic field, which is promising for various biomedical and industrial applications, including minimally invasive medical procedures and targeted delivery. Precise magnetic actuation requires the use of bottom-up fabrication techniques in which magnetic interactions are well-controlled on the level of the structural element. **The objective of this PhD project is the fabrication of magnetic soft robots via the assembly of magnetic, bio-based, porous particles with tailored magnetic anisotropy and mechanical properties.** The use of these new building blocks should allow for simple and scalable shaping of soft magnetic robots. Magnetic iron oxide nanoparticles will be embedded within bio-based aerogel beads (nanostructured, stable and porous materials) and different methods for the assembly of these beads into macroscopic structures will be investigated. Also the magneto-mechanical properties and actuation capacity of the granular materials will be explored towards their use as soft robots.

This ambitious, explorative and interdisciplinary project is located at the interface of material science, polymer processing, magneto-mechanics, soft robotics and soft matter. The majority of the work will be performed at CEMEF in Sophia Antipolis in the south of France. This lab has extensive experience in the preparation and physico-chemical characterization of polymer-based materials, including bio-based aerogels. The magneto-mechanical characterization and actuation capacity of the bio-aerogel bead assemblies will be carried out at the SIMM lab in Paris, which has an international reputation when it comes to magnetic soft robotics and mechanical characterization of soft materials. Budget has been reserved for mobility between the two involved laboratories and for dissemination of results at national and international conferences.

Keywords: Bio-based polymers, porous materials, physico-chemical properties, magnetic materials, soft robots

Profile: Knowledge of materials science, ideally with experience in soft matter and rheology or mechanics; fluent in English; taste for initiative; MSc thesis completed

Duration: 3 years, starting in autumn 2025

Locations: CEMEF (part of MINES Paris but located in Sophia Antipolis in the south of France) and SIMM (part of ESPCI Paris, France)

Funding: PSL University (METASOFT program)

People involved: Dr. Sijtze Buwalda (MINES Paris), Dr. Artem Kovalenko and Dr. Loren Jørgensen (both ESPCI)

Please send your detailed CV, motivation letter, marks of your Bachelor and Master courses and at least two e-mail addresses of reference persons to sijtze.buwalda@minesparis.psl.eu before July 1st, 2025.