University of Colorado Boulder

ESPCI PARIS | PSL

Internship proposal

Magneto-mechanics of soft magnetic foams

Supervisors: Franck Vernerey (franck.vernerey@colorado.edu),
Artem Kovalenko (artem.kovalenko@espci.fr)

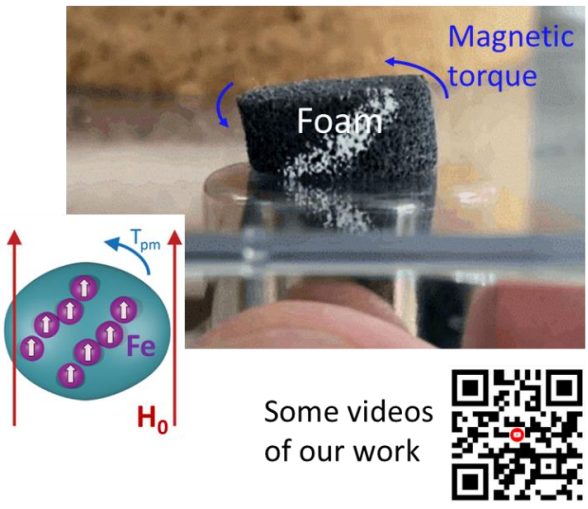
Place: SIMM-UMR7615-ESPCI, University of Colorado Boulder

Period: April-August 2024 (flexible)

Funding: Travel costs fully covered, gratification is possible

Dry adhesive tapes, such as Scotch® tapes or adhesive pads, are one of the most widely used inventions of the 20th century. However, the adhesion power of those products is usually opposite to the possibility to re-use them multiple times: a sticky tape is difficult to remove, often leaves traces on the surface and may cause pain in medical applications. The use of the magnetic field as a contactless and instant stimulus for switching the adhesion is very promising and needs new material design.

In the PhD thesis of Maxime Bès at ESPCI, we developed a new approach to obtain soft surfaces with adhesion properties that can be switched by magnetic field-induced compression and detachment from a substrate of a soft elastomer foam filled with iron particles. Leveraging our collaboration with Franck Vernerey from University of Colorado Boulder, we were able to model the compression behavior of the foam in a field of a body-like magnetic force induced by a magnet.



Some videos of our work

The next step is to use the unique nature of the magnetic fields which induce anisotropic and gravity-like forces, to control the behavior of the triple line in adhesive contacts. In this internship, we aim to develop models to describe the effects of magnetic torques on soft and compressible materials. The most of the work will be done under supervision of Franck Vernerey, but in contact with the ESPCI experimental team. We will base our strategy on the expertise of the team from Boulder in modelling of mechanics of anisotropic media, such as liquid crystalline elastomers, and combine it with our recent experimental findings on magnetic foams.