PhD Thesis Offer @ UJM / ECL

Magnetic Hyperthermia in Vitrimers

Scientific Context

Vitrimers are dynamic covalent polymer networks that combine the mechanical robustness of thermosets with the reprocessability of thermoplastics. Their architecture relies on exchangeable covalent bonds, enabling stress relaxation and reshaping upon thermal activation. In parallel, magnetic hyperthermia (MH) has emerged as a versatile technique in which magnetic nanoparticles (NPs) dissipate heat under alternating magnetic fields, with applications ranging from cancer treatment to self-healing materials and catalysis. Integrating MH with vitrimer chemistry opens exciting perspectives for the engineering of remotely activable and healable systems, where external fields trigger targeted reshaping or welding. Beyond these technological prospects, vitrimers provide a unique platform for fundamental investigations: their well-defined viscoelastic transitions make it possible to probe how the NP environment influences MH efficiency, and to disentangle the various microscopic heating mechanisms across the vitrimer network dynamics.

Research Focus

The PhD project aims to integrate magnetic NPs within vitrimer matrices to achieve spatiotemporal control of their structural and functional properties through MH. Particular emphasis will be placed on advanced experimental characterizations, including rheology under controlled magnetic induction and synchrotron-based SAXS/XPCS studies, to probe the structure and dynamics of NPs during MH treatment.

The main objectives are:

- Design and synthesize vitrimer-based networks whose topology can be selectively modified via MH activation,
- Disentangle and quantify the distinct heating mechanisms operating in confined vitrimer environments,
- Develop functional vitrimer-based nanocomposites for applications in electrical insulation, with tunable rheological and self- or stimulus-healing responses.

PhD Position and Research Environment

We are looking for a highly motivated candidate holding a Master 2 (or equivalent) degree in polymer science, soft matter physics, or materials chemistry. The ideal applicant will demonstrate a strong enthusiasm for experimental research, combined with solid analytical skills. Good communication abilities and a genuine interest in teamwork are essential, as the project will be carried out in a dynamic and collaborative research environment.

The PhD thesis, fully funded by the ANR project AIRMAGNET (**starting date: Jan. - Oct. 2026**), will be primarily based at the brand-new Campus *Manufactures* in Saint-Étienne, benefiting from state-of-the-art facilities. It will also involve frequent visits to École Centrale de Lyon for the part of the project devoted to electrical characterization and the generation of controlled electrical damage, which will subsequently be healed via magnetic hyperthermia. The research will be conducted in close collaboration with Dr. Romain Tavernier, Pr. Eric Drockenmuller, and Dr. Anatoli Serghei at the IMP laboratory (Université Claude Bernard Lyon 1), ensuring access to complementary expertise in chemistry and dielectric characterization.

Contact

Interested candidates should send a CV, motivation letter, and contact details of referees to:

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