

PhD position: Anisotropically stretchable hydrogels with adhesive properties for wound dressing

Bioadhesive materials and patches offer a promising alternative to traditional surgical sutures and staples. However, many currently available bioadhesives fail to meet the requirements of clinical surgical procedures. This limitation is especially critical for wound dressings designed for dynamic organs and tissues which are constantly in motion and exhibit anisotropic mechanical properties due to their hierarchically organized structures. Biodegradable and biocompatible hydrogels show numerous advantages for wound healing, however their use in clinical applications is still limited due to the lack of strong adhesion, fragility under stress and their inability to closely mimic the deformation of anisotropic tissues.

This PhD project proposes to conceive and study stretchable biocompatible composites with adhesive properties for wound dressing of mechanosensitive anisotropic tissues.

The experimental work will focus on development of adhesive and structurally anisotropic hydrogel nanocomposites. To achieve it, the project will involve the synthesis of magnetic nanoparticles conjugated with cellulose nanocrystals to facilitate the anisotropic alignment within the hydrogel. The mechanical properties of materials in both longitudinal and transverse directions will be evaluated. Electronic microscopy technics will be used for morphology characterization of synthesized materials. Furthermore, SAXS will verify the anisotropic orientation of nanorods. To ensure strong adhesion of the dressing material to tissue surfaces, various chemical and physical adsorption strategies will be explored. Uniaxial tensile tests, lap-shear and 90° peel tests will assess the mechanical properties, adhesion strength and energy required for separation from the studied substrates.

The PhD will take place in the Research Center on Vegetal Macromolecules (CERMAV) in Grenoble, France. The CERMAV is a leading research laboratory in the field of glycoscience, with strong and multidisciplinary expertise that spans from chemistry, physical-chemistry, biology to material sciences and aims at addressing major societal challenges in the fields of human health, emerging energies and materials for new technologies. Ideally located on the campus of the Grenoble Alpes University (UGA), the CERMAV actively contributes to the exceptional scientific and technological environment present in the Grenoble area. The PhD candidate will be supervised by B. Jean - the head of "Structure and Properties of Glycomaterials" (SPG) team and A. Szarpak from "Structure and Modification of Polysaccharides" (SMP) team. B. Jean is expert in nanocellulose production, derivatization and surface and bulk assembly with the aim of designing functional biosourced materials using soft matter concepts. A. Szarpak has expertise in the hydrogels design towards biomedical applications. The collaborations are envisaged.

The position is intended for a highly motivated student with an extensive theoretical knowledge and a solid practical experience in the field of polymer chemistry and physical chemistry and/ or material science. The candidate should have a good command of English and be willing to engage in multidisciplinary activities (chemical synthesis, physico-chemical characterization, mechanical measurements). He/She should be able to work collaboratively in a highly interdisciplinary and international environment and to properly record, organize and analyze data as well as to report on his/her findings.

Funding: The project will be funded by the Labex Arcane (<https://arcane.univ-grenoble-alpes.fr/>).

The application deadline is the 11th of April 2025.

Your application should contain:

- A resume with references and a motivation letter
- An academic transcript for the two past years
- At least one recommendation letter

Contacts

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