

**Position title: PhD Position**

**“Predicting the multiscale mechanics of gelatin-based and freeze-dried hydrogels: from cyclic behaviour to damage mechanisms”**

**Characteristics of the position:**

Functions/ features	<b>PhD student in mechanics of materials and structures</b>
Employment type (referens III )	BAP C – Engineering Sciences and Scientific Instrumentation (UGA6000)
Category	A
Body	Doctoral student on doctoral contract
Quotas	100%

**Assignment:**

- 3SR Laboratory (*Soils, Solids, Structures, Risks Laboratory*; Grenoble, France): 1<sup>st</sup> assignment
- TIMC Laboratory (*Translational Research and Innovation in Medicine and Complexity*; Grenoble, France): 2<sup>nd</sup> assignment
- The successful candidate will have a 36-month doctoral contract at the Université Grenoble Alpes.

**Context and work environment**

**Structure description**

The project is a collaborative work between two labs of the [LabEx Tec21](#), which gathers research laboratories for mechanical and process engineering: the [3SR lab](#) and the [TIMC lab](#) (Grenoble, France). The partners are two local laboratories of CNRS and Univ. Grenoble Alpes (UGA), owning complementary skills and resources:

- The **3SR Lab** (UMR5521, CNRS - UGA) gathers experts in solid mechanics, material and structural engineering. In particular, **through the CoMHet research group**, active research is carried out in mechanics and physics of fibrous/porous (bio)materials, with recent developments on freeze-dried nanocellulose foams, as well as soft-tissue biomechanics applied to human vocal folds and their biomimetic design using gelatin-based hydrogels.
- The **TIMC Lab** (UMR5525, CNRS - UGA) gathers scientists and clinicians towards the use of computer science and applied mathematics for understanding and controlling normal and pathological processes in biology and healthcare. This multi-disciplinary activity both contributes to the basic knowledge of those domains and to the development of systems for computer-assisted diagnosis and therapy. The project will be part of the **Biomecamot team**, particularly interested in the mechanics of materials for medical applications and soft tissues, and in motricity.

**Team description (N+1 and colleagues) :**

The successful applicant will be hosted by the 3SR Lab in the “CoMhet” team, which is composed of 29 agents (13 permanent researchers; 10 PhD students and 6 post-docs). He/she will work under the supervision of Lucie BAILLY (3SR), in collaboration with Laurent ORGEAS (3SR).

A part of his/her work will also be conducted in the “Biomecamot” team of the TIMC Lab, composed of 24 agents (among which 13 permanent researchers; 7 PhD students and 2 post-docs). He/she will work under the co-supervision of Grégory CHAGNON (TIMC).

**Position’s mission and main activities**

**Mission:** Hydrogels are 3D networks of hydrophilic polymers able to absorb and hold a large amount of water while keeping a solid-like mechanical behaviour. Their softness and structural similarities with human soft tissues make them materials of choice for biomedical applications. More particularly, active research is underway to develop gelatin-based hydrogels to replace vocal-fold tissues for surgical voice restoration. While the development of new gelatin-based and freeze-dried hydrogels seems a very promising option to meet this current challenge, scientific knowledge must be first strengthened on the mechanics of such gels at various scales and loading frequencies, while tuning their inner solid architecture. In particular, the damage mechanisms likely to occur after repeated loading, and the damping properties revealed after a disturbance, need to be studied in greater depth.

Therefore, this PhD aims (i) to design and process new gelatin-based and freeze-dried hydrogels suitable for the biomimetic substitutes of living soft tissues; (ii) to build and validate a suitable theoretical model able to predict their multiscale time-dependent mechanical properties, including their non-linear viscoelastic, damping and damage behaviour after repeated loads.

**Main activities:**

To achieve this goal, the candidate's activities will be divided into four major experimental and theoretical steps:

- Step 1 will aim at elaborating new microstructured gelatin-based hydrogels using recent freeze-drying techniques.
- Step 2 will aim at characterising the various 3D architectures generated in the solid phase of each material processed in step 1, using advanced micro-imaging techniques and quantitative analyses;
- Step 3 will aim at characterising the mechanical properties of the materials elaborated in step 1 in response to complex cyclic paths, at various spatial scales (macro/micro) and loading frequencies (low/high).
- Step 4 will be devoted to proposing a micro-to-macro mechanical model able to predict the overall mechanical behaviour (viscoelastic, damping and damage properties) of the processed hydrogels.

**Restriction or constraints related to the position**

The PhD fellowship offer is available starting **October 2025** for a period of **3 years**. The gross salary will be 2200 €/month. The candidate will be subject to the internal regulations of the 2 labs that will host him/her.

**Desired profile**

**Expected skills (priority) :**

- **Trade skills / expertise**
  - Candidates with expertise in solid mechanics, material and structural engineering are expected.
  - Specific skills in soft material science, process engineering, physico-chemistry of hydrogels, 3D micro-imaging of heterogeneous materials (X-rays, SEM), damage modelling and/or experimental mechanics will be strongly appreciated.
  - Additional knowledge in vibromechanics and/or biomechanics of soft tissues will be interestingly examined.
  - English level: from B1 to C2 (Common European Framework of Reference for Languages)
- **Personal skills**
  - Strong motivation and involvement in the research project
  - Curiosity and autonomy for science watch
  - Scientific rigour
  - Teamworking

Supervisory mission:  Yes  No

Number of agents supervised per category: ..... A, ..... B, ..... C

**Desired professional experience:**  beginner  2 to 5 years

**Previous formation, diplomas:** Candidates with academic backgrounds (Master Diploma and/or Engineering Diploma) in solid mechanics, material and/or structural engineering are expected. Experience in the public domain would be appreciated.

## ***General information***

Interested candidates should send their CV, a cover letter and official transcripts of the last two years to Dr Lucie BAILLY (3SR), and Dr. Grégory CHAGNON (TIMC).

Contact for the questions related to the position:

**Dr Lucie BAILLY (3SR Lab)**

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**Dr Grégory CHAGNON (TIMC)**

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