# Associate researcher position
# 21 months

LMGC/ICUBE/LEM3

**05/01/2026**

This position takes part of an ANR project (2023-2027) entitled Hydro-chemo-mechanical characterisation of a mucoid matrix for medical applications.

Context: The consortium's knowledge of Wharton's jelly (WJ) derivatives, which exhibit good biomechanical repeatability (Baldit et al, 2022; Dubus et al., 2022a,2022b) and allow modulation of cross-linking (Scomazzon et al., 2024), GAG content (Scomazzon et al., 2021) and/or environment, is a strength for characterizing hydro-chemo-mechanical couplings in soft biological tissues. Moreover, as a product destined for destruction and promising for future medical applications, enriching knowledge of hydro-chemo-mechanical couplings in WJ appears to be a crucial element for medical innovation.

Objectives: Joining a multidisciplinary team, the main objective is to work on digital twins mimicking the hydro-chemo-mechanical behavior of WJ derivates *ex-vivo* at first while taking part to the *in-vivo* assessment to then integrate it.
The main hypothesis is to consider the couplings between solid and fluid phases, as well as the chemical components of both, specifically electrically charged GAGs combined with collagen as well as physiological ions. The fluid-structure interaction will be modeled as a homogenized continuous medium within the framework of poro-mechanics, while the chemo-mechanical coupling will be generated by chemical potential equilibrium through osmosis (Chetoui et al., 2022). Based on preliminary results, it is considered that adjusting cross-links (Lavrand et al., 2024) and GAG content (Scomazzon et al., 2021), on geometrically controlled structures, is sufficient to modulate interaction phenomena. This will make it possible to discriminate between hydromechanical and chemomechanical couplings. Finally, the combination of multimodal imaging techniques during the execution of hydro-chemo-mechanical loading and the monitoring of the animal's response to material integration should provide sufficient data to enable the construction of predictive tools.
Currently, experimental data are collected to assess the viscous behaviour of the WJ derivates (Da Rocha et al., 2024) but also their damage for surgical applications (Da Rocha et al., 2025b).

Required skills: The predictive simulation will be developed through Finite Element Analysis (FEA) in between LMGC and ICube and LEM3 Labs. Therefore, FEA poro-mechanical simulation experience is a plus (Le Floc'h, et al., 2024). Besides, in-vivo bio-integration will be monitored thanks to magnetic resonance imaging (MRI) at ICube that is why knowledge on medical imaging as well as digital twin building is a substantial plus for non-contact characterization (Da Rocha et al., 2025a).
This position will require traveling between Montpellier (LMGC) and Strasbourg (ICube).

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