Self-Assembling of Peptide-Based Gels: A Multiscale Structural Analysis

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Supramolecular hydrogels have drawn much attention in the past years especially because of their broad range of applications from material science to medical science domains. Peptide-based gels have been developed lately [1, 2], mainly thanks to their higher modularity and possibilities of functionalization compared to polymer gels [3, 4]. Mechanisms of forming peptides hydrogels are starting to be examined: first is the gelation of nanofibrous peptides assemblies and is observed predominantly with oligopeptide precursors. Gel formation in such systems involves supramolecular assembly of precursors into nanofibers, -tapes, -tubes, or -ribbons that entangle and form nonspecific.

The capability of peptides and proteins to form gels is long time known, as gelatine used in cooking. But the development of gel materials was mostly built on serendipity. Moreover, only a few publications are found on relationships between the mechanical properties of the gel materials and their self-assembling [5-7], although the mechanical properties are very important for the applications. As a mesh has a different appearance depending on whether the knitting is tight or loose, there is a correlation between morphology and number of fibrils and mechanical properties of the obtained material. But so far, no rules were found that can predict which peptide sequence, or peptide modification leads to self-assembling in a gel and what kind of soft material it will give. This observation is the starting point of our project.

The assumption is the following: the self-assembling process and the interactions involved in the first stages has an impact on the size, morphology, number of fibrils and, subsequently, on the material properties. study the interactions from the inter-molecular level to supra-molecular, meso-level, and macroscopic properties, to investigate the relationships between self-assembling of the peptide-based molecules and the resulting mechanical properties of gels. In the Laboratoire de Chimie Physique Macromoléculaire, we associate synthesis of gelling molecules, physical chemistry analysis, structural and 3D conformational modelling studies, imaging, and rheology experiments to evaluate correlation between the structural and self-assembling to mechanical properties of the resulting soft material.

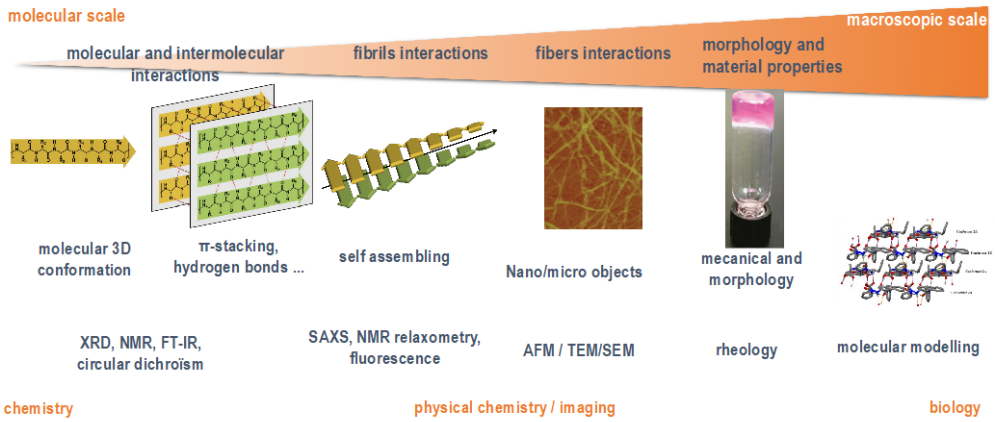

FIGURE 1. Multiscale structural analysis of self-assembling peptide-based gels.

To that end, a multiscale approach has been undertaken from molecular scale to macroscopic scale the interactions involved in the materials (Figure 1) to decipher their influence on the soft material formation and guide chemists to the next generation of gelling molecules.

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