Designing peptide-based biomaterials: structure and related properties

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Recently, scientific as well as technological interest in the synthesis of novel peptide-based hydrogel materials have grown dramatically. Applications of such materials mostly concern the biomedical field with examples covering diverse sectors such as drug delivery, tissue engineering and production of scaffolds for cell growth, thanks to their biocompatibility and biodegradability [1].
In this framework, we have explored the phase diagram of molecular gels produced from a solution of the aromatic polypeptide derivative fluorenyl-methoxycarbonyl(poly)phenylalanine (Fmoc-polyPhe) [2]. Our experiments indicate the importance of phenylalanine in the gel formation, suggesting that different combinations of Fmoc-polyPhe promote the formation of gels with different strength and fluidity. Furthermore, we have characterized the kinetic of gelation demostrating its reversibility. By combining Dynamic Light Scattering and Fourier Transform Infrared Spectroscopy techniques we have revealed that the gel structural details strongly depends on temperature suggesting a specific mechanisms of formation. The complex self-assembled networks formed by nanofibers has been investigated by Atomic Force Microscopy investigation on hydrogels deposited on mica, and the structural details of the nanofibers have been determined.
These information can be used for a rational optimization of the design and of the applications of novel hydrogels.

[1]H. J. Chung, T. G. Park 2009. Self-assembled and nanostructured hydrogels for drug delivery and tissue engineering. Nano Today 4: 429-437.
[2]N.A. Dudukovic and C. F. Zukoski 2014. Mechanical Properties of Self-Assembled Fmoc-Diphenylalanine Molecular Gels. Langmuir 30: 4493−4500.

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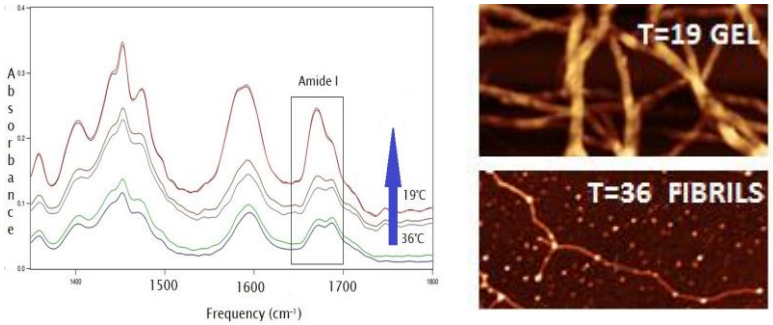

Figure 1. Fourier Transform Infrared Spectroscopy and Atomic Force Microscopy investigation on hydrogel to different temperature