Supramolecular hydrogels from short glycosylated peptide amphiphiles

Filipa Duarte[1,2], Alexandra Brito[1,2], Rui L. Reis[1,2,3], Ricardo A. Pires[1,2,3], Iva Pashkuleva[1,2]

[1]3B's Research Group, I3Bs – Research Institute on Biomaterials, Biodegradables and Biomimetics, University of Minho, Headquarters of the European Institute of Excellence on Tissue Engineering and Regenerative Medicine, AvePark, Parque de Ciência e Tecnologia, Zona Industrial da Gandra, 4805-017 Barco, Guimarães, Portugal; [2]ICVS/3B's–PT Government Associate Laboratory, Braga/Guimarães, Portugal; [3]The Discoveries Centre for Regenerative and Precision Medicine, Headquarters at University of Minho, Avepark, 4805-017 Barco, Guimarães, Portugal

The ability of nanotechnology to shape the materials at the nanoscale is gaining growing interest due to its repercussion in the properties of the materials and their interaction with the surrounding environment. Template-free supramolecular nanoassembly is a bottom-up approach that allows fabrication of new biomaterials (e.g. nanotubes, nanospheres, nanofibrils) with defined morphologies that can be used in wide variety of applications, going from nanostructures for the controlled growth of cell populations and for cell therapies to more sophisticated assemblies that can be used in vivo to promote regenerative processes. The use of materials that can undergo self-assembly in conditions that are cell-compatible and can be injected into the body in a minimally invasive way is very appealing.

So far, mainly extracellular matrix (ECM) proteins and/or their small peptide epitopes that copycat specific sequences have been explored in the development of supramolecular hydrogels able to host cells and protect proteins. Nevertheless, the ECM contains another class of biomolecules – glycans – that do also play important roles in tissue structuring and function.

In fact, glycosylation is the most important post-translational modification of proteins that can alter their stability and activity. Here, we propose to use short glycosylated peptide amphiphiles for the assembly of supramolecular gels. The amphiphiles are obtained from the respective peptide analogue (e.g. N-fluorenylmethoxycarbonyl diphenylalanine, Fmoc-FF) and a monosaccharide (e.g. glucose, galactose) through 1-Ethyl-3-(3-dimethylaminopropyl)carbodiimide/N-hydroxysuccinimide (EDC/NHS) coupling. We aim to investigate the influence of different saccharide units on the assembly process, the properties of the generated nanoassemblies and their gelation at physiological conditions. Cell encapsulation and targeted delivery will be further explored.