Editorial corner – a personal view

Hydrogels and bionanocomposites from peptide self-assembly

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The development of new hydrogels having building blocks based on peptides has increased exponentially since the discovery of their capability to self-assemble (<https://doi.org/10.1002/sml.201500169>). Therefore, systems based on small dipeptides and even large amphiphilic block copolymers have been evaluated for applications such as bio-printing, tissue engineering and drug delivery ([https://doi.org/10.1016/S1748-0132\(08\)70041-0](https://doi.org/10.1016/S1748-0132(08)70041-0), <https://doi.org/10.1016/j.bioactmat.2019.01.002>). Interest in these hydrogels derives from the specific properties that can be achieved by fine tuning their composition. Among them, stand out the biocompatibility and mechanical robustness, as well as, the ability to mimic the extracellular matrix (ECM). The establishment of physical and reversible cross-links under physiological conditions and the modulation of their functional behaviour is remarkable. Furthermore, peptide based hydrogels can be designed to have shape memory effects, suitable for minimal invasive surgery and to show self-healing and shear-thinning properties. Such compounds can be used as stimuli-responsive smart materials with minimum immune response or applied as in situ gelling polymers. It should be remarked that solid-phase synthesis has facilitated the design of peptides with specific sequences and functionality to accomplish the required properties and even to mimic naturally occurring protein motifs.

The interest of peptide based hydrogels increases when they are combined with hydroxyapatite (HAp) nanoparticles since this inorganic compound provides bioactivity, osteoconductivity and becomes a key component of hard tissues (e.g. bone, teeth and cartilage) (<https://doi.org/10.3390/gels5010014>). Besides, these bionanocomposite systems are ideal to

simulate ECM characteristics. Specifically, the hybrid structure composed of HAp and proteins and the specific particle morphologies (*i.e.* high aspect ratio and diameter in the nanoscale range) contribute to their applicability as cellular scaffolds. In fact, new bionanocomposites can be easily obtained following two methodologies: the binding of peptide anionic groups to the calcium cations being present on the surface of HAp nanoparticles or alternatively the self-assembling of peptide amphiphiles that subsequently can promote the nucleation of HAp nanoparticles. Different amphiphilic and thermoreversible block copolymers having HAp-nucleating peptides have been for example developed as injectable materials. These allow a good control of the mineralization process being able to adopt the shape of a hard tissue defect and render solids under physiological conditions (<https://doi.org/10.1557/JMR.2008.0388>). Despite the indicated potential advantages of hydrogels and bionanocomposites based on peptides there are different challenges that still should be faced before achieving materials with real clinical uses. For instance, a deeper research on the bionanostructure stability, the impact on the immune system and the control of the effects caused by external stimuli is needed.

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