Biomaterials as scaffolds for tissue regeneration, antimicrobial carriers, materials engineering, and energy applications

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ABSTRACT

Natural biomaterials are a rich source of inspiration for translating fundamental structural knowledge into concrete integration strategies and applications in the area of bio-nano-materials. We especially focus on the use of peptide materials as technological objects and their integration in innovative applications. These efforts rely not only on biochemical and structural methodologies, but also on the fostering of interdisciplinary collaborations with colleagues from other disciplines (eg laser science) that develop techniques to manipulate, assemble and position these materials in a controlled manner [1]. Recently, we reported on the antimicrobial efficiency of encapsulated porphyrins into peptide hydrogels as delivery vehicles. We selected the self-assembling Fmoc-Phe-Phe dipeptide, a biocompatible gelator, and three water-soluble porphyrins as photosensitizers [2]. We evaluated their antimicrobial efficacy against Gram-positive *Staphylococcus aureus* and Gram-negative *Escherichia coli* bacteria. We found out that the hydrogels are cytocompatible and display antimicrobial efficiency against both strains. These natural biomaterial-based hydrogels present a promising alternative for combating bacterial infections in the face of growing antimicrobial resistance concerns. Finally, when the diphenylalanine dipeptide was chemically attached to a porphyrin macrocycle conveyed self-assembling properties to the resulting hybrid. The Sn derivative of this hybrid was able to produce hydrogen photocatalytically with superior efficiency compared to the amorphous chromophore molecules [3]. Overall, the self-assembling potential of minimal building blocks such as peptides can be exploited for generating novel materials with superior properties and real-life application perspectives.

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