Structure and properties of polystyrene-grafted natural fibers for biomedical applications

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In biomaterials, there is growing interest in naturally derived materials, which possess excellent biological and mechanical properties [1]. Silk fibers from *Bombyx mori* and *Antheraea pernyi*, as well as wool fibers, are protein-based biomaterials with outstanding properties that can be readily tuned to meet specific functional requirements through strategies such as grafting [2].
This study examined the structure and properties of silk fibroin and wool keratin fibers grafted with polystyrene (PS) at different weight gains (10-110%). PS was reported to modulate the fibers' physical (tensile strength), chemical (hydrophobicity), and biological (inertness to biological attack) properties [3]. Their performance in biomedical applications was evaluated with respect to bioactivity (promotion of calcium phosphate nucleation) for bone tissue engineering and metal ion binding (particularly Ag^+ ions) for potential use as antimicrobial materials.
IR and Raman spectroscopies were used to study the structure of the grafted natural fibers. Combining the two techniques provided complementary information, as the former is sensitive to the surface and the latter to the bulk. Spectroscopic data provided insights into the efficiency of the grafting mechanism, which involved polar amino acids (mainly serine) and induced an increase in the ordered domains of fibroin and keratin. The IR technique also allowed the study of the orientational order of fibers after grafting, which is relevant to their mechanical and biological properties (such as morphology and cell proliferation [4]).
Bioactivity testing in SBF (Simulated Body Fluid) solutions showed nucleation of a thin calcium phosphate layer, dependent on both PS content and fiber origin. An analogous behavior was observed in the silver ion uptake assay. These preliminary results were encouraging and supported the role of grafting in modulating the bioactivity and metal-adsorption properties of PS-grafted silk fibroin and wool keratin fibers.

References

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