Plasma Bio-Engineering: Functional Interfaces and Nanomaterials for Biomedicine Applications

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Implantable medical devices are increasing in global prevalence, with hundreds of thousands of operations performed annually. However, a significant proportion of these operations experiences failure due to infection and/or poor integration with host tissues. Biomimetic functionalization of surfaces enables control over the biological response by signalling through immobilized proteins and other biomolecules. Here we present a novel approach for the fabrication of radical-rich organic coatings that are chemically and mechanically robust for surface engineering of implantable medical devices [1-5]. Our results demonstrate that multifunctional protein layers, peptide molecules, or even silver nanoparticles can be covalently immobilized on such radical-rich interfaces for improved cellular activity and enhanced antimicrobial properties. Our recent findings provide evidence on utilizing this technology for polymerization and covalent attachment of hydrogel layers [6], as well as tuning the orientation and density of immobilized molecules on surfaces by simply tuning pH or applying external electric fields during the biomolecule immobilization [7]. The plasma bio-engineering approach presented here holds great promise to create the next generation of bioactive materials and interfaces for biomedical implant applications and beyond.

References

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Figures