Nano-Structured Coatings for the Next Generation of Health Therapies

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Over the last 50 years, biomaterials, prostheses and implants saved and prolonged the life of millions of humans around the globe. Today, nano-biotechnology, nanomaterials and surface modifications provides a new insight to the current problem of biomaterial complications, and even allows us to envisage strategies for the organ shortage. In this talk, creative strategies for modifying and engineering the surface and the interface of biomaterials, including metals, polymers from natural and synthetic sources, will be discussed. The unique potential of low-pressure low-temperature plasma surface modification will be detailed with the overall aim to envisage today how far innovation can bring tomorrow solutions for reparative and regenerative medicine. Applications for health will be emphasized, including biologically active-based, biomimetic, low-fouling, bactericidal, and antiviral coatings.

The first example will be focused on amorphous carbon coatings. Diamond-like carbon (DLC) is a generic term that refers to at least seven forms of amorphous carbon materials, which vary depending on their sp^3, sp^2, and hydrogen content. These films display some of the unique properties of natural diamond and have consequently received considerable interest in the biomedical field (1). Then, few examples on how the established platform was developed and targeted to different health-related industrial applications, including clinical, surgical, textiles, medical devices, dental and cosmetic will be discussed, in an effort to clarify links between academic research and industrial development for innovation (2).

The second example will focus on the next generation of pro-active stents. The use of plasma-based techniques to create functional groups (reactive amine groups, -NH2), directly onto the metallic surface without modifying the bulk properties, can succeed and allow further grafting of bioactive molecules (3). Overall, this research allowed the development and validation of a promising strategy to directly immobilize bioactive molecules onto L605 cobalt chromium cardiovascular devices, providing clear advantages of medical devices currently on the market. Furthermore, a new stent, showing promising features succeeded in vivo testing (4), and it is now under pre-clinical assessment.

References

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