MATERIALS SCIENCE AND TECHNOLOGY

Ateneo - Surface coating and functionalization of implants with molecules featuring a multifunctional action

Funded By	Politecnico di TORINO [P.iva/CF:00518460019]
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Context of the research activity	The aim of the research is to fulfil some current unmet requirements of materials for implants: low risk of infection and modulation of the host response. In the case of permanent implants, this means an antibiofilm action and modulation of the inflammatory response with an early pro-inflammatory and a secondary anti-inflammatory action to avoid the development of fibrotic tissue. In the case of resorbable implants, the kinetic of bio-resorption must be modulated, too. The area of interest covers orthopedic, dental, and cardiovascular implants. The materials of interest are mainly titanium and magnesium alloys.
Objectives	The strategy of the research is to use natural biomolecules in the form of coatings or surface grafting or adsorption. Synthetic compounds derived from or inspired by natural biomolecules can be also used. These include polyphenols and tannins derived from different plants, eventually chemically modified, or peptoids. The challenging feature of these molecules is their multifunctional ability. They can reduce the risk of infection by hindering the implant surface colonization by bacteria or with an active anti-bacterial action. The eventual role of quorum sensing in the antibacterial mechanism will be also investigated. On the other side, they can modulate the inflammatory response with a chemical redox and radical scavenging action. As last, they have the ability to form surface films that can modulate the corrosion rate and bio-resorption of degradable metal alloys such as magnesium ones. The synergic use of different compounds and organic/inorganic surface doping will be also tested. The research involves: 1) the selection of the molecules of interest 2) the selection of the type of surface modification: coating, grafting, physisorption, or chemisorption 3) the selection of the technology for surface modification or activation: dipping, spin coating, plasma 4) the optimization of the process parameters: pH, temperature, solvent,

	duration, atmosphere, and washing … 5) the chemical and physical characterization of the modified surfaces: SEM-EDS, fluorescent microscopy, topography, zeta potential, AFM, FMKP, XRD, wettability, FTIR, and UV-Vis spectroscopy, ICP … 6) investigation of the surface stability and eventual corrosion 7) the selection of the models for the biological tests 8) biological tests: cell cultures, biofilm formation, biocompatibility, co-cultures of cells and bacteria or different cells A part of the research will be performed in collaboration with external research groups (or companies), such as the University of Belgrade, University of Erlangen, Fraunhofer-Institut für Keramische Technologien und Systeme IKTS, and Wroclaw University of Science and Technology.

Skills and competencies for the development of the activity	Skills and knowledge of material science and technology, biomaterials, and materials/surface characterization.