

MATERIALS SCIENCE AND TECHNOLOGY

AMMIN/DISAT - Surface modification strategies to improve biomaterials performances at the interface with their working environment

Funded By	Dipartimento DISAT Politecnico di TORINO [P:iva/CF:00518460019]
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Context of the research activity	<p>The research is focused on the surface modification (e.g. plasma, e-beam, laser, functionalization) of biomaterials in order to improve their performances at the interface with the working environment. The working environment can be represented by biological fluids, cells and tissues in case of implantable biomaterials and surfaces intended for direct contact with the body but also other biomaterials in case of joining of different components in the framework of an implantable devices.</p> <p>Surface modifications will be designed and implements starting from industrial and clinical need and characterized with a multidisciplinary approach.</p>
Objectives	<p>The surface plays a crucial role in the performances of biomaterials in contact with the biological environment or with other biomaterials, its proper modification is a powerful tool for the optimization of the final performances. This research is a multidisciplinary activity were materials science meets companies producing medical devices (involved in the activity), clinicians and biologist in order to collect industrial and clinical needs to be met with proper design of materials and also to investigate biological and industrial performances of developed surfaces.</p> <p>Part of the research is funded by a regional project (SilHeads, fundeb by Piedmont Region in the framework of SWIch 2024 call, CUP E13D24000830006) devoted to sustainable process for the development of polymeric components of defibrillators and pacemakers and their optimized assembly. Surface activation and characterization will play a crucial role in the design and optimization of components to be joined with sustainable routes. Activation procedures (e.g. plasma) will be performed on model samples and real devices components and fully characterized to deeply investigate the impact of the process on material surfaces features (e.g. chemical composition, charge, wettability, reactivity) and to properly understand the interaction of these surfaces with adhesives in the joining process. Moreover, investigation of the adhesives will be performed to better investigate interface phenomena.</p>

Surface modifications and their characterization will be also explored in order to optimize the biological performances of selected biomaterials with particular attention to their ability to reduce bacterial adhesion, tailor cellular adhesion (depending on the target contact tissue) and control the inflammatory process upon implantation. Moreover, activation and functionalization procedures will be designed and developed with specific focus on sustainability (e.g. natural molecules, low toxicity reagent, environmentally sustainable processes). As for the first point, the main aim of the research is to find correlations between surface properties and biological response in order to exploit the possibility to design specific surface features in function of the specific working environment of the materials. Innovative and state of the art characterization techniques (e.g. XPS, FTIR-ATR, AFM and KP-AFM, zeta potential, wettability and surface energy determination, SEM and confocal microscopies, profilometry, ...) will be employed for a complete characterization of the surfaces to be critically compared with biological investigations performed in close collaboration with biologist and biotechnologists to support the correlation between specific surface parameter and the possibility to tailor defined biological paths.

Skills and competencies for the development of the activity

The research is focused on the surface modification and characterization of biomaterials, basic knowledge in the field of biomaterials and their characterization is requested for this work. Interdisciplinary attitude and background will be useful for the development of the project. Basic experience and attitude in experimental laboratory activity and data collection and elaboration (average and standard deviation, graphs to plot data trend) are welcome.