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Surfaces and Interfaces in Bioengineering Systems

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'God made the bulk; surfaces were invented by the devil'.(Pauli)

Surfaces and interfaces within the biological environment present a range of exciting, yet challenging, problems to understand and optimise. This is reflected by the vibrant, active and highly dynamic research activities in this field being conducted across the world. The benefits and impacts of this research has brought measurable impact to many areas of bioengineering and continues to do so. This is typically manifested in enhanced patient outcomes, minimising the need for further intervention and enhanced consumer interactions. The scale and nature of this activity has motivated this special issue in Surface Topography: Metrology and Properties.

Research to understand and optimise surfaces and interfaces in bioengineering systems has been of interest to many groups. Advances in measurement techniques, collaboration between various areas of the physical sciences and the need to optimise new medical devices and treatment are some of the main drivers that have kept this area of interest very much at the forefront of science and engineering. It has long been recognised that an understanding of the processes and reactions occurring at biomedical surfaces and interfaces are key to ensuring the success of any material or device in-vivo; echoing the eloquent sentiments of Pauli.

Surfaces and interfaces are present in all bioengineering systems. Perhaps one of the unique aspects of this area are the length scales in which interactions and processes occur; from the molecular understanding of how charges, ions and macromolecules interact with a surfaces to the application of engineering principles to understand how a system or device may behave through a surface or interface. Whilst interfacial science and engineering has long been acknowledged, it is only in recent times that the magnitude of its importance has come to the forefront. As a result, many industries now recognise that the key to a successful device or product is dependent on functional surfaces and interfaces. As a consequence, collaborations between academia and industry in the field of biotribology have never been so strong. This is also reflected in national and international funding incentives which are becoming ever more focused on translation of science toward clinical benefit or industry application.

Without a doubt the main driver behind this research is to engineer and functionalise a surface or interface with the view to produce a device or system with optimal performance in-vivo. However as part of this journey, an understanding of the factors

and processes involved, need to be developed. The papers presented in this special issue reflect the nature and extent of activity in the area; contributing to some of the key and pertinent issues facing academia and industry.

Three papers look at the corrosion and tribocorrosion of materials typically used in implant materials, each presenting a unique perspective and opinion on modelling mechanically enhanced electrochemical processes [1], the interaction of novel Mg alloys with the local biology [2] and the roles of tribology on protein adsorption [3]. Also being considered is the tribology of personal care products, ranging from incontinence management [4] to hair-care [5]. Interfacial properties, such as friction and wear, are been used a predictor of skin health outcomes and to develop consumer personal care products. Another contribution considers the optimisation of surfaces using novel precision-machining methods with a view to reduce wear-induced osteolytic reactions for artificial joints [6]. At the nanoscale, the behaviour of confined water, particularly the effects of hydrogen bonding between silica surfaces, has been considered [7], further demonstrating the multi-scale, multi-disciplinary nature of processes occurring at surfaces and interfaces.

The editors are pleased to present this collection of papers which enhances our current understanding around surfaces and interfaces in bioengineering systems and addresses some of the key issues facing modern medical systems. We hope that the work presented will be of interest across the bioengineering community and will help address some of the current challenges in this exciting and critical field.

References

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