Nanoengineering of plasma polymers for advanced biomedical devices

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Abstract

In this keynote talk, I will give an overview of recent progress from my lab on development of advanced surfaces capable of controlling infection, inflammation and stem cell differentiation. Over the last few years, we have created the means to control the entire spectrum of surface properties including chemical, physical, mechanical and topographical. We do that by nanoengineering and tailoring traditional plasma polymer films using tools from nanotechnology. By controlling surface properties, we are able to address medical challenges that are often encountered with implantable devices such as infection and inflammation. We have developed four distinct classes of antibacterial surfaces that are suitable for application on various medical devices. These surfaces can be classified based on their mechanism of action as non-sticky, contact killing, antimicrobial compound releasing and stimuli responsive. I will provide examples and describe the strategies used to create these types surfaces, including such being translated onto commercial devices in collaboration with industry. Recently, we have also revealed that the mechanism of surface nanotopography induced modulation of inflammation is the unfolding of adsorbed fibrinogen. This unfolding is surface nanotopography scale dependent and leads to the exposure of (normally hidden) peptide sequences that activate the MAC-1 receptor of immune cells. Finally, I will report on a bladder cancer diagnostic technology that we are currently commercializing.

Biography

Professor Vasilev completed his PhD at the Max-Planck Institute for Polymer Research in Mainz, Germany in 2005. He is currently an NHMRC Fellow and a Humboldt Fellow, and a Full Professor at the University of South Australia. His research focuses on engineering and tailoring at a molecular level of the disciplinary interphase, where biological entities interact with biomaterials and devices. He is the author of more than 200 publications, 5 patents and has been awarded in excess of 20 million dollars of research funding. His work results in translation of research discoveries to tangible commercial outcomes such as device for bladder cancer diagnostics and antibacterial surface for hip and knee implants, both technologies being currently industrialized with commercial partners. For his work, he has received various honors and awards such as the John A. Brodie Medal for achievements in Chemical Engineering in 2016 and the International Association of Advanced Materials Medal (IAAM medal) for contributions to the field of Advanced Materials in 2017. In 2017, he was elected a Fellow of the Royal Society of Chemistry (FRSC).