Journal of Applied Polymer Science

Special Issue: Bioactive Surface Functionalization

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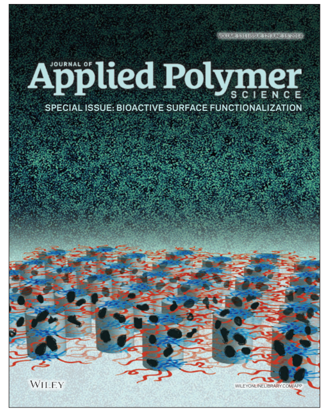

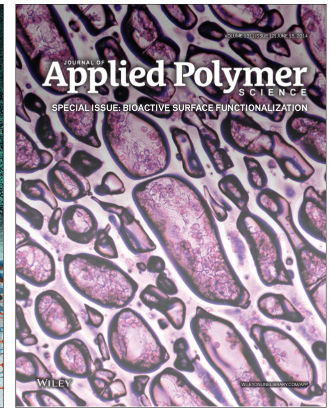

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JOURNAL OF Applied Polymer SCIENCE

EDITORIAL

Bioactive Surface Functionalization

Many different materials (metals, polymers, ceramics, and composites) are used for biomedical applications. The bulk property of a material is often a key factor in its selection for a particular application, for example titanium and its alloys are widely used as orthopedic implants because they have the appropriate mechanical properties. However, the surface characteristics of a material, including its wettability, charge, chemistry, and topographical features, govern its interaction with its environment. These interfacial interactions are highly complex in a biological environment such as blood, and when a material is placed in this environment, adsorption of proteins occurs within milliseconds.[1] The adsorbed proteins subsequently influence cellular events at the surface, which may or may not be desirable for the functionality of the material. For example, deposition of fibrin on central venous catheters and formation of blood clots may lead to catheter malfunction and serious complications such as pulmonary embolism.[2] Bacterial cells also readily attach to materials surfaces, and catheters inserted into the body often serve as a nidus for bacterial colonization, and consequential infections. Conversely, surfaces of orthopedic implants have to promote bone cell adhesion and functions to prevent implant failure. Similarly, scaffolds for tissue engineering must be devised to support cell adhesion, proliferation, and differentiation. Thus, a major challenge for materials intended for use in biological environments is the necessity to control the interfacial phenomena to suit the application. This difficulty is aptly illustrated by the quote, "God made the bulk; surfaces were invented by the devil" attributed to Wolfgang Pauli, 1945 Nobel laureate in Physics.[3] Nevertheless, in recent years, great strides have been made in the development of new approaches to modulate the physicochemical surface properties of materials.

This special issue on Bioactive Surface Functionalization provides a collection of papers highlighting the wide range of strategies that can be used to tailor surfaces to achieve particular interactions with biological systems. The collection comprises three review and several primary research articles. The reviews give an overview of three approaches for modulating the bioactivity of surfaces: reactive chemical vapor deposition polymerization, blending with surface additives and surface modifying macromolecules, and the use of block copolymer thin films for the creation of ordered arrays of proteins or peptides. Each approach has its unique advantages, limitations, and applicability with respect to the bulk material and desired surface functional groups. Ten of the primary research papers address ways of modulating interfacial phenomena such as blood protein adsorption/thrombogenicity, and cell and bacterial response while the remaining two papers discuss modifications involving collagen, the most abundant protein in mammals. The systems conferred with bioactivity include microparticles, fibers, films, hydrogels, and scaffolds, and consist of both man-made materials as well as biopolymers. Surface modification techniques described include the introduction of nano- and microfeatures, and functionalization with the appropriate polymers or biomolecules. The diversity of the research is a reflection of the numerous potential applications of bioactive surfaces. Undoubtedly much work remains to be done in this important area, and with the progress that is being made in the development of surface modification strategies, the range of applications of bioactive surfaces will correspondingly increase.

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