Surface Modification of Biomaterials For Enhanced Biocompatibility, Bioactivity, and Antimicrobial Activity

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Abstract

The interactions between biomaterials and biological tissues / body fluids depend on the surface properties of the biomaterials as well as biological responses of the host. However, many types of biomaterials with favorable bulk attributes cannot produce the desirable biological and biochemical effects *in vivo*, and surface modification is one of the effective ways to alter selective surface properties to address specific needs. By using the proper modification techniques, surface properties such as biocompatibility, bioactivity, and bacterial resistance can be enhanced selectively and at the same time, the inherent bulk properties of the materials such as mechanical strength and durability can be retained. Our research group has been conducting research on surface modification of a variety of materials and devices for more than 20 years. For example, plasma immersion ion implantation and deposition (PIII&D) is a non-line-of-sight technique especially suitable for biomedical implants with a complex shape. In our research on biodegradable materials, since the interfaces between biodegradable biomaterials and tissues / body fluids are dynamic, the techniques must be able to optimize the interfacial physics and chemistry in order to achieve the goal of controlled and timely degradation of the implanted materials while delivering the desirable therapeutic outcome *via* chemical and physical effects. In addition, we are investigating different ways to improve the antibacterial activity of biomaterials, including fabrication of unique nano/micro surface features as well as using electrical signals to attract and kill bacteria on contact. Wearable biomedical and health-monitoring devices are becoming very popular nowadays and our recent research on making flexible and wearable biomaterials antibacterial will also be discussed.

Keywords: Surface modification; biomaterials; biocompatibility; bioactivity; bacteria resistance; plasma technology