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MATERIALS FOR BIOMEDICAL ENGINEERING

THERMOSET AND
THERMOPLASTIC POLYMERS



Laser surface texturing of thermoplastics to improve biological performance

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2.1 INTRODUCTION

Thermoplastic polymers are characterized by long linear or branched chains of molecules. The polymer chains associate through intermolecular forces, make these materials soften when heat is applied, and can be shaped and retain that shape upon cooling. This process is reversible, which makes these materials ideal candidates to be processed by injection molding. Therefore, this is a key property in designing and developing biomedical implants (Puskas and Chen, 2004). Typical thermoplastic polymers used in biomedical applications are ultra-high-molecular-weight polyethylene (UHMWPE), polylactic acid, polyether ether ketone (PEEK), polypropylene (PP), nylon, and various polyesters, among others. Thermoplastic polymers exhibit the excellent mechanical properties required in implants for applications such as knee or hip implants, orthopedic devices, dental implants, ligature clips, tissue staples, and skin covering devices or stents, among others. In addition to the potentially suitable mechanical properties and reduced density of thermoplastics compared to other biomaterials (namely, metals and ceramics), they do not interfere with or deteriorate the biological tissue they are in contact with. This property is essential for biomedical applications. All these features make thermoplastic polymers potentially suitable biomaterials. Hence, over the past few years substantial research has been focused on the use of these materials for biomedical applications (Puskas and Chen, 2004; Shoichet et al., 1994; Lin et al., 2005; Van et al., 2012; Fernández-D'Arlas et al., 2015).

Although these materials are biocompatible and have mechanical properties similar to those of human tissues (e.g., bone), they are chemically and biologically inert, showing a minimum interrelation with the tissues or cells in contact. The advantage of this is that they do not release any toxic constituents to the human body environment. However, on the downside, the body usually responds