Synthesis and characterization of titanium-45S5 Bioglass nanocomposites

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1. Introduction

Titanium and titanium alloys are common in dental implant applications because of their desirable properties, such as relatively low Young's modulus, good fatigue strength, corrosion resistance, biocompatibility as well as formability and machinability. However, titanium and its alloys cannot meet all of the clinical requirements. Current research focuses on improving the mechanical performance and biocompatibility of Ti-based systems through variations in alloy composition, surface treatment and microstructure [1–7].

One of the methods that allows the change of biological properties of Ti alloys is the modification of its chemical composition [2]. Current goals in the development of new Ti-based biomaterials are: (i) to avoid potentially toxic elements, such as vanadium, to further improve biocompatibility; (ii) to produce titanium alloys with a high fatigue strength but a low Young's modulus compared to cortical bone (E = 10–25 GPa), (iii) to minimize stress shielding and improve fracture healing. Ti-6Al-7Nb, which has been developed for surgical implants, is also attractive for dental applications [8].

Surface modification technologies, such as grit blast, chemical etching, and plasma spraying are often utilized to improve the osseointegration ability of titanium dental implants [4–6]. Additionally, to enhance the physicochemical and mechanical performance of implant materials through microstructure control, the top-down approaches known as mechanical alloying (MA) and severe plastic deformation (SPD) techniques were applied [7,9–15]. Recent studies proved clearly that nanostructuring of titanium can considerably improve not only the mechanical properties, but also the biocompatibility [15]. This approach also has the benefit of enhancing the biological response of the CP titanium surface [16].

Till now, a number of SPD methods for producing bulk ultra fine grain metals/ alloys have been developed [13–15]. Valiev and co-workers apply a process known as equal channel angular pressing (ECAP), which is a viable processing route to grain refinement and property improvement [13]. Their study reports of nanostructured titanium, produced as long-sized rods with superior mechanical and biomedical properties and which demonstrates its applicability for dental implants. It turns out that the extreme grain refinement of the bulk of the metal down to nanoscale transpires to

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