Titanium-based porous materials with nanostructured bioactive surface for enhanced osseointegration

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Abstract:

Despite the great progress that has been achieved in orthopedics biomaterials, fixation of implants to the bone host remains a problem. Mismatch of Young's moduli of the biomaterials and the surrounding bone has been identified as a major reason for implant loosening following stress shielding of bone. However, the implanted material must be strong enough and durable to withstand the physiological loads placed upon it over the years. A suitable balance between strength and stiffness has to be found to the best match of bone behaviour. Titanium and its alloy (Ti6Al4V) have elastic moduli less than 50% of that commonly used Co–Cr implants so that their use helps reduce the extent of stress shielding.

One consideration to achieve this has been the development of materials that exhibit substantial surface or total bulk porosity in medical applications.

Moreover, bioactive surface chemical composition and suitable surface morphology on micro- and nanoscale level is necessary for efficient osseointegration.

Here we report on novel concept of hierarchically functionalized titanium based biomaterials consists in (i) laser induced surface porosity, (ii) micro/messoporous bioactive glass fillers, (iii) chemical activation and/or ablative deposition of bioactive CaTiO3 nanoparticles. Prepared biomaterials were analyzed using SEM/EDX, XRD, Raman spectroscopy and test in terms of cell cultivation in order to reveal biocompatibility, cell viability and osseointegration ability.

Key words:

Biomaterials, titanium, porosity, nanostructured surface, chemical activation, cell viability