

Bulk and Mesoscopic Thermodynamic Studies of Inorganic Biocompatible Materials Utilizable for Mimetic Bone Tissue Substitution in Dentistry

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Today's capability of the bone-like apatite formation on the surface of a suitably adjusted implant composition is of a key importance during the physical and chemical processes leading to the bonds configuration between the implanted material and the newly formed bone tissue. Despite higher brittleness bio-glass-ceramics is used in a broad spectrum of pieces suitably functional when implanted inside the human body. Such utilizability is only possible due to the possibility to adjust biocompatibility on basis of its four environmental factors: (i) Appropriate adjustment of a bulk prefixed glass composition optimized upon the thermodynamic calculation of the extent of non-bridging oxygens in the glass lattice assuming polymeric character of the common matrix silicate glass [1]. The smartness of subsequent mimetic process is likely the action of silanol groups (Si-OH), which can serve as the sites for bio-compatible volume/interface formation capable to coexist within the original tissue and the implants [3]. (j) However, the harmonization of morphological structure of matching surfaces (porosity to allow body-liquid communication, fractal self-similarity) is also inevitable. Thus a fine tuning (ij) of surface capability to support nucleation and intergrowth of osteoblasts is necessary and can be induced even on a metallic titanium by coordinated acid (Ti-H) and alkali (Ti-OH) treatment [2], which, moreover, enables utilization of mechanically stable implants. However, a further molecular manipulation such as (ji) the addition of surfactants, doping micro-additives of various organic molecules (such as bone morphogenic proteins) is oftentimes necessity to achieve easier mineralization. This study was supported by grant No A100100639 of the Grant Agency of the Czech Academy of Sciences.

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