Bioactive composites in tissue engineering, and in biomedical applications

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It is very important to provide long-term success of implanted biomaterials, such as ceramic-polymer composites in both tissue engineering and other biomedical applications. To achieve this, a high level of biocompatibility and bioactivity are required from the applied materials, either in scaffold or in coating form. Bioactive ceramic composites (BCCs) are especially useful materials in soft and bone tissue engineering and even in dentistry. They can be the solution to many medical problems, and they have a huge role in the healing processes of bone fractures. Interestingly, they can also promote skin regeneration and wound healing. The bioactive ceramics are able to attach to the bone tissues and form an apatite layer which further promotes the biomineralization process. The formed intermediate apatite layer makes a connection between the hard tissue and the bioactive glass material which results in faster healing without any complications or side effects. The properties and biological performance of these unique composites can be adjusted to meet the standard requirements of biomedical applications. The main approach is that the bioceramic bone cements or grafts or even coatings can act as an initiative intermediate surface for the increase in bone cell attachment, growth, and proliferation as well as new bone formation. Calcium phosphate (CaP)-based ceramic–biopolymer composites can be regarded as innovative bioresorbable scaffolds or coatings on load-bearing implants that can promote the osseointegration process. The bioactive ion modified amorphous carbonated apatite (cAp) phase is the most suitable CaP form, since it has sufficient similarity to the mineral phase in human bones, and the highest biodegradability rate as well. The crystallinity or amorphous characteristic and particle size of CaP particles are strongly dependent on the preparation and post-treatment methods, such as heat or alkaline treatment of as-precipitated powders.