Chitosan-based porous composites for tissue engineering

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Abstract.

Chitosan is a kind of antibacterial, but biocompatible and biodegradable, environmentally friendly polysaccharide and has been widely used in various branches of clinical medicine and tissue engineering. Structure and strong intra- and intermacromolecular hydrogen bonding interactions of chitosan result in poor intrinsic mechanical properties. However its natural origin and high biocompatibility make it possible to use this polymer both for osteosynthesis purposes and for growing neurotissues.

In this work, we consider the problem of creating polymer porous composites based on chitosan filled with reduced graphene oxide and tricalcium phosphate. The shape of the sponge was chosen as a substrate for growing neurons and the cellular bone matrix. As is known, electrically conductive materials are optimal for stimulating the growth of nerve cells; therefore, reduced graphene oxide, with concentrations of up to 10% are chosen as fillers. For the formation of bone matrices, filling up to 25% of tricalcium phosphate was used.

The obtained chitosan composites were investigated by optical and scanning electron microscopy, impedance spectroscopy and high-resolution ultrasonic microscopy; the analysis of physical and mechanical properties was carried out on a universal tensile testing machine. Ultrasonic microscopy has shown high efficiency for non-invasive visualization of the microstructure and quantitative determination of the tricalcium phosphate and reduced graphene oxide concentration in the chitosan sponges. The paper shows the optimal degree of filling of the polymer matrix to achieve bio-adequate properties of electrical conductivity. The required tricalcium phosphate loading to provide bio-adequate mechanics compatible with native tissues was also investigated.