Vibrational spectroscopy as a tool for biomaterials study

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Bone defect is one of the most frequent problems in bone tissue reconstruction in which application of a biomaterial filling is necessary. It creates a still rising demand of biomaterials for the bone surgery. Polymer-ceramic nanocomposites is a group of novel materials which properties such as strength, Young's modulus, bioactivity and controlled degradation time make them suitable materials for filling a bone defects.

The aim of the work was to obtain polymer nanocomposites whose matrix consisted of a natural polysaccharide – chitosan (CS) to which montmorillonite as a composite nanometric filler (MMT-K5, MMT-K10, MMT-Nanomer) was added. The applied biopolymer (CS) is a biocompatible and biodegradable material with mechanical properties similar to a bone. The ceramic nanofiller (MMT) was introduced in order to facilitate matching of mechanical properties between the nanocomposite and a bone and to enable control of its degradation time. The control of the above mentioned mechanical properties and material's durability in *in vitro* and *in vivo* conditions is possible only in the case of nanocomposites characterized by high level of dispersion of the nano-filler in the matrix.

The nanocomposite materials were obtained by a casting method. Ultrasound stirrer was used to obtain a better homogenization of the nanofiller particles within the biopolymer matrix. Four types of MMT with different particle size (DLS) and specific surface area (BET) were used. In one case, MMT nanoparticles were organophilised with third-order amine (MMT-Nanomer). The nanoparticles' morphology was examined by electron microscopy (SEM/TEM). Nanocomposite chitosane/montmorillonite foils with a varying content of ceramic nanoparticles were prepared.

The nanocomposites and montmorillonite nanoparticles were investigated using FT-IR and PIXE techniques. FT-IR method is a particularly efficient tool for the surface analysis of nanosized materials. This technique was used to determine dispersion of MMT nanoparticles in a polymer matrix. We observed a correlation between the concentration of nanoparticles and structural changes of the nanocomposite surface. These results were confirmed by SEM/EDS study.

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