Development of the silanization process for spherical aluminosilicates dedicated as filler for polymers used in medical devices

Abstract

The topic of this dissertation concerns an issue related to improving the properties of materials used in the treatment of bone defects and the attachment of implants to bone. Correct filling of the defect should ensure stability and integration of the implant with the body minimizing the risk of complications. Currently used materials, i.e. aluminum oxide or zirconium oxide, despite their good mechanical properties, do not always guarantee a good connection with the matrix in the bone cement, which can lead to fractures.

The dissertation adopted the theme of developing a silanization process for three selected materials (Al_2O_3, ZrO_2 and spherical aluminosilicate with fractions C_{90}, C_{150} and C_{212}). Each of these materials was subjected to three modifications using silicon nitride with sodium hydroxide (Si_3N_4+NaOH), 3-aminopropyltriethoxysilane (APTES), Tetraethoxysilane (TEOS). One type of aluminosilicate with a 150μm fraction, after modification from silicon nitride with sodium hydroxide (Si_3N_4+NaOH), was selected on the basis of chemical composition, phase composition, microstructure, as well as thermogravimetric studies of the surface. The second part of the conducted research was the verification of the produced composite. For this purpose, chemical composition, surface morphology, porosity, wettability as well as strength tests were performed. Biological evaluation was also carried out by performing a cytotoxicity test.

The results of the aforementioned studies showed the beneficial effect of using spherical aluminosilicate filler in polymer matrix bone cements.