Description for the general public

Polyoxymethylene (POM) is high quality thermoplastic engineering polymer, characterized by high mechanical strength and low friction coefficient in typical matching of materials, applied also in biomedical field. Due to its excellent mechanical properties, POM was applied as hip and knee prostheses, occluder disc of the heart valve and in dentistry as a substitute for acrylic resins and metals in many prosthetic applications. Results obtained many years after implantation have not revealed wear on the articulating POM components as well as the histological studies of the surrounding tissue show a benign tissue response similar to that seen around polyethylene implants. However, the used POM-based materials were bioinert, while for orthopaedic application bioactive materials are favourable due to ability to direct bond to living bone without the formation of surrounding fibrous tissue. Another problem is sensitivity of POM to elevated temperatures and its relatively low thermal stability, especially in the presence of hydroxyapatite.

In view of these observations, the main goal of this project is to investigate the influence of hydroxyapatite (HAp) surface modification (by grafting of poly(ethylene glycol) (PEG) using isocyanate coupling agent to obtain hybrid inorganic-organic nanofiller (HAp-g-PEG)) on the properties of POM/HAp-g-PEG systems. In our previous studies, it was found that incorporation of HAp-g-PEG nanofillers to polyoxymethylene matrix leads to significant improvement in the thermal stability of polymer matrix and allows introducing higher HAp loading to polymer matrix compared to unmodified HAp – introduction of 10 wt. % of non-modified HAp into POM copolymer leads to decreasing of its thermal stability at ca. 30°C, while incorporation of 10% (in recalculation to pure HAp) hybrid nanofillers HAp-g-PEG leads to improving of POM thermal stability at 32°C.

Additionally, application of HAp-g-PEG system shall make it possible to obtain POM-based composites with higher HAp loading, which is desired in orthopaedic applications. In the proposed project systematic basic research to get new knowledge concerning the influence of kind of isocyanate, PEG average molar mass and ratio of substrates in HAp-g-PEG system synthesis on the properties of POM/HAp-g-PEG composites is planned. The results obtained should allow selecting the best system for potential biomedical applications.