conferenceseries.com SciTechnol
Beata Macherzyńska et al., J Nanomater Mol Nanotechnol 2018, Volume 7
DOI: 10.4172/2324-8777-C2-023

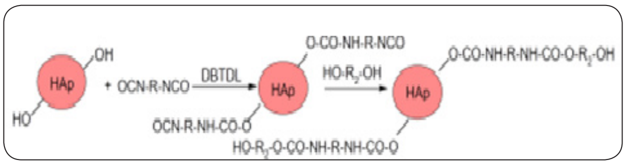
24th World Nano Conference

May 07-08, 2018 | Rome, Italy

Mechanical properties of polyoxymethylene/functionalized hydroxyapatite nanocomposites

Beata Macherzyńska, Klaudia Król-Morkisz, Piotr Szatkowski and **Kinga Pielichowska**
AGH University of Science and Technology, Poland

Polyoxymethylene (POM) is a widely used engineering thermoplastic polymer devoted to technical and biomedical applications. However, POM is a bio inert polymer and to improve its biocompatibility it has been modified with hydroxyapatite (HAp) and functionalized HAp. HAp functionalization was performed using diisocyanates as coupling agents to graft polymer chains (poly (ethylene glycol) (PEG) or poly(e-caprolactone) (PCL)) on the surface of HAp nanoparticles to obtain HAp-graft-PEG or HAp-graft-PCL as shown in Scheme1. Next, HAp and functionalized HAp have been incorporated to POM matrix using melt processing methods. The obtained nanocomposites were investigated as potential biomaterials for orthopaedic applications. The mechanical properties and durability are crucial issues in orthopaedic applications. The influence of HAp and functionalized HAp on mechanical properties of polyoxymethylene nanocomposites was investigated using both conventional mechanical tests as well as non-destructive ultrasonic methods. It was observed that the mechanical properties strongly depend on the crystallinity of obtained nanocomposites. Moreover, kind of POM (homo- or copolymer), POM average molar mass, kind of grafted polymer and its average molar mass (chain length) influence Young modulus and other mechanical properties. From non-destructive ultrasonic investigations it has been found the highest values of velocity of propagation both longitudinal and transverse waves and Young's/shear modulus were for POM homopolymer (DH) and POM copolymer T2H. This effect can be explained by higher degree of crystallinity of these matarials in comparison to UH copolymer. Additionally, excellent POM nanocomposites durability and stability of mechanical properties even after 1000000 mechanical loading cycles were observed evidencing an enhancement of mechanical properties by HAp nanoparticles.



Scheme 1: Functionalization of HAp nanoparticles with PEG or PCL using 1, 6-hexamethylene diisocyanate as a coupling agent.

Recent Publications:

1. Król K, Macherzyńska B and Pielichowska K (2016) Acrylic bone cements modified with poly (ethylene glycol)-based biocompatible phase-change materials. Journal of Applied Polymer Science 133(36):43898.
2. Pielichowska K, Nowak M, Szatkowski P and Macherzyńska B (2016) The influence of chain extender on properties of polyurethane-based phase change materials modified with graphene. Applied Energy 162(15):1024–1033.
3. Brzezińska-Miecznik J, Haberko K, Sitarz M, Bućko M M and Macherzyńska B (2015) Hydroxyapatite from animal bones – extraction and properties. Ceramics International 41(3):4841–4846.
4. Pielichowska K, Bieliński D, Dworak M, Kilian E, Macherzyńska B and Błażewicz S (2017) The influence of nanohydroxyapatite on the thermal, mechanical, and tribological properties of polyoxymethylene nanocomposites. International Journal of Polymer Science. 2017: Article ID 9051914. https://doi.org/10.1155/2017/9051914.

Biography

Beata Macherzyńska has completed her PhD and is a Lecturer at the Faculty of Materials Science and Ceramics, AGH University of Science and Technology. Her scientific interests are mechanical properties of polymer nanocomposites, particularly in the areas of (i) materials for thermal energy storage, (ii) polymer (nano) composites for biomedical applications, and (iii) degradation and defects in materials studied by ultrasonic methods. She is currently performing research dedicated to selected engineering polymer/hydroxyapatite nanocomposites for bone implants. The designed and fabricated polyoxymethylene nanocomposites with hydroxyapatite and functionalized hydroxyapatite show an increase in bioactivity and advantageous *in vitro* stability.

beatam@agh.edu.pl