Forsterite porous nanoceramics as a novelty in medical applications

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The main purpose of this study is to develop novel nanoceramics based on forsterite (F) with high bioactivity and enhanced mechanical properties for medical applications. Forsterite nanoceramics were obtained by two methods using solid state (FS) and sol-gel (SG) synthesis. Their powders were pressed into pellets and thermally treated at different temperatures, 1200°C, 1300°C, and 1400°C. The compactness characteristics of the obtained forsterite ceramics were determined. The median apparent porosity of FS ceramics falls in the range of 17-46%, while that for SG ceramics is of 27-39%. With the increase in temperature, the apparent porosity of FS ceramics decreases comparatively to that of SG ceramics. In vitro bioactivity testing was performed by immersing the FS and SG ceramic pellets into simulated body fluid (SBF) for 1 week to several months. The formation of hydroxyapatite on the surface and within the pores of FS and SG-derived forsterite ceramics is confirmed even after 1 week, by X-ray diffractions (XRD). After 3 months of immersion in SBF, the surface of forsterite ceramic is covered by an organized fibrous network of hydroxyapatite elongated crystals. This fibrous hydroxyapatite was evidenced by atomic force microscopy (AFM). Mechanical characteristics were also determined, both by compression, flexural strength and Young modulus by nanoindentation. FS ceramics showed a median flexural strength of about 24 MPa, about 4 times higher than that of SG ceramics (6 MPa). The value of the Young modulus determined through nanoindentation falls in the range of 40 to 50 MPa for SG ceramics, and between 87 to 101 MPa, for FS ceramics. The novelty element of this investigation is also represented by the use of forsterite at nanometric scale, as porous nanomaterials with improved mechanical properties for bone grafts, as coatings for innovative metallic implants, and as drug delivery systems for orthopaedic medical applications.

Speaker Biography

Alexandra Avram is an Ph.D. candidate and a research assistant at the Physical Chemistry Center, Faculty of Chemistry and Chemical Engineering, Babe-Bolyai University. Her research interests include nanomaterials, biomaterials for bone tissue engineering (glass, ceramics, and composites) and drug delivery.

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