Thermal and biological properties of several composite materials prepared by sol-gel method.

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Zirconia/hydroxyapatite composites were synthesized by means of the sol-gel method. The aim of this work is to identify the temperature able to induce specific degradation phenomena or structural reorganizations, which are essential information to explain the relationship between the different biological responses recorded after exposure to the materials to the temperatures of the applied post-synthesis heat treatments.

The zirconia matrix and pure Hap were synthesized using Zirconium propoxide solution and calcium nitrate tetrahydrate and phosphorus pentoxide as precursors. Finally, the composites were obtained by adding different amounts of zirconia sol to the HAp one. The thermal behavior of all the materials was studied. The TG/DTG curves of all the samples, before thermal treatment and after 120° heating, suggest that the thermal treatment at relatively low temperature does not modify the thermal behavior of these composites. The results of the FTIR spectra of the gaseous mixture evolved during the TG experiments of fresh samples and their composites at different temperatures show that in all the samples the heating up to about 600 ° C allows the complete degradation of the organic substance and of the nitrate ions. SEM microscopy suggests that all samples, regardless of the thermal treatment, are homogeneous composites. Furthermore, the XRD spectra of the composite materials treated at 120°C revealed that they are amorphous, while at 600 and 1000°C, their crystallinity decreases with increasing the content of zirconia; the presence of HAp favours the crystallization of the zirconia matrix in the tetragonal phase [1].

The effects of the HAp content and heating on the biological performances of ZrO_2 were evaluated using NIH-3T3 cells. The biological results suggest that the materials heated to 100 ° C improves the cellular vitality compared to those treated to 600°C [2]. Probably these effects are due to the modification of the materials' structure induced by heating.

In conclusion, the results of the study of thermal behavior and biological characterization allow to identify the best temperatures able to improve cell proliferation and vitality.

[1] M. Catauro, F. Bollino, E. Tranquillo, R. Tuffi, A. Dell'Era, S. Vecchio Ciprioti. Ceram. Int. 45 (2019) 2835–45
[2] F. Bollino, E. Armenia E. Tranquillo Materials 10 (2017) 757

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