Synthesis and characterization of bioactive glasses and glass-ceramics of the $MgO-CaO-P_2O_5-B_2O_3$ system

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ABSTRACT:

We report in the present master diploma the synthesis and bioactivity study of glasses and glass-ceramics of various compositions in the system: $MgO-CaO-P_2O_5-B_2O_3$. Samples were prepared according to two different synthetic routes. The sol-gel method and the fast quenching of high temperature melts with a twin roller device. X-ray diffraction, Raman and Infrared spectroscopes, DTA/TG thermal analyses, EDS chemical analyses and in-vitro bioactivity and biodegradation studies were used for the characterization of the samples.

As concluded from the sol-gel method, high concentration calcium systems can not give stable and not hydroscopic gels, while boron contributes in the synthesis and the bioactivity of the samples. Of particular interest is the $0.3MgO-0.3CaO-0.2P_2O_5-0.2B_2O_3$ composition which demonstrates bioactivity. It is clear from the EDS chemical analyses that a substituted hydroxyapatite phase grows on the surface of the 500^oC gel pellet, which restructures to pure hydroxyapatite after several weeks in SBF. Crystallization study at 800^oC of the same sample showed the creation of β-TCP phase and in-vitro biodegradation studies were held with Trizma solution.

$0.3MgO-0.3CaO-0.2P_2O_5-0.2B_2O_3$, $0.6MgO-0.2P_2O_5-0.2B_2O_3$ and $0.64MgO-0.16P_2O_5-0.2B_2O_3$ compositions were prepared with fast quenching of high temperature melts. All three compositions showed reduced bioactivity compared with corresponding calcium systems. Crystallization studies were performed and it was

concluded, as for the gels too, that crystal phases that grow consist of orthophosphate groups, while the boron groups form a separate amorphous network consisting mainly of pyro and meta borate groups.

The comparison of the compositions prepared by the two different methods and the bioactivity of those compositions is reported for the first time in literature.