

phase) and calcium sodium phosphate (NaCaPO_4). These glass-ceramics are bioactive, forming an apatite layer on their surface after immersion in SBF for 30 days. Apatite-forming ability improved with the increase of the ZnO and Fe_2O_3 amount in the parent glass (Singh and Srinivasan, 2010b). Samples with low concentration of ZnO and Fe_2O_3 (below 9 mol%) are paramagnetic (Singh and Srinivasan, 2011). For higher concentrations of ZnO and Fe_2O_3 (above 9 mol%), the samples exhibit a ferrimagnetic behavior. Maximum magnetic hysteresis loss is obtained for samples with higher ZnO and Fe_2O_3 content (21 mol% of ZnO and Fe_2O_3) (Singh and Srinivasan, 2011).

Glasses in the same SiO_2 -CaO- Na_2O - P_2O_5 - Fe_2O_3 -ZnO system, containing up to 10 wt% ZnO, were obtained by melting these oxides using oxyacetylene flame (Shah et al., 2010a). The glass was ground, pressed into pellets, sintered at 1100 °C for 3 h, and rapidly quenched at -10 °C. The crystalline phases identified after sintering were zinc ferrite (ZnFe_2O_4), wollastonite (CaSiO_3), and hydroxyapatite ($\text{Ca}_{10}(\text{PO}_4)_6(\text{OH})_2$). Small quantities of hematite (α - Fe_2O_3) were produced for glass compositions with an ZnO content lower than 6 wt%. Rapid cooling from 1100 °C to -10 °C preserved the high-temperature random distribution of Zn^{2+} and Fe^{3+} ions at tetrahedral A sites and octahedral B sites of ZnFe_2O_4 , leading to the ferrimagnetic structure of ZnFe_2O_4 . Calorimetric measurements using a magnetic field of 500 Oe and 400 kHz for 2 min showed that the maximum specific power loss (26 W/g after 2 min) was obtained for samples containing 10% ZnO. These samples are bioactive, showing the formation of hydroxyapatite after immersion in SBF for 3 weeks (Shah et al., 2010a). Magnetic properties of these glass-ceramics were enhanced by heating the samples to 600 °C and cooling them in an aligned magnetic field of 1 Tesla to introduce magnetic anisotropy (Shah et al., 2010b). The heat generation of the resultant anisotropic glass-ceramics containing 10% ZnO, using a magnetic field of 500 Oe and 400 kHz for 2 min, increased from 26 W/g to 31.5 W/g (Shah et al., 2010b).

Magnetic bioactive composites containing manganese ferrite (MnFe_2O_4) were prepared by sintering pressed mixtures of manganese ferrite and wollastonite-fluorapatite glass powders (1:10 wt ratio) at 1200 °C for 2 h, followed by rapid cooling in air (Li et al., 2011). Manganese ferrite was synthesized by a two-step sintering process. Mixtures of MnO_2 and Fe_2O_3 powders (1:1 molar ratio) were heated at 980 °C for 1.5 h, ground, sieved, and reheated at 1200 °C for 2 h. The glass having the composition in the system CaO- SiO_2 - P_2O_5 -MgO-CaF₂ was obtained by melting sol-gel-derived starting powder at 800 °C for 1 h and 1150 °C for 2 h. The main crystalline phases identified in the composites were wollastonite (CaSiO_3) and fluorapatite ($\text{Ca}_5(\text{PO}_4)_3\text{F}$). Small amounts of other phases such as MnFe_2O_4 , (Fe,Mg,Ca) SiO_3 , and $\text{CaMnSi}_2\text{O}_6$ crystallized during sintering. These phases affect the magnetic properties of the composite. After soaking in SBF for 14 days, hydroxyapatite precipitated on the surface of the composite samples. The composite had slower bioactivity kinetics when compared with the sol-gel-derived glass. Thus, MnO_2 and Fe_2O_3 decreased the bioactivity of the