EFFECT OF HEAT TREATMENT CONDITIONS ON THE CRYSTALLINE STRUCTURE AND MAGNETIC PROPERTIES OF GALLIUM-COBALT FERRITES


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Magnetic nanoparticles of magnetite (Fe$_3$O$_4$) and mixed ferrites (MFe$_2$O$_4$, M= Co, Zn, Mg, Ca, etc.) are materials with a great variety of medical and technological applications due to their important and distinctive magnetic properties. In this work, the effect of the heat treatment time on the properties of Co$_{0.5}$Ga$_{0.5}$Fe$_2$O$_4$ nanoparticles for their use in biomedical applications was studied. Samples were synthesized by sol-gel method using tetraethylene glycol as reaction medium and were heat treated at 500 °C for 30, 60, 90 y 120 min. The crystalline structure and the magnetic properties of synthesized samples were characterized by X-Ray diffraction and vibrating sample magnetometry. A single phase of spinel structure was identified for the samples heat treated for 30 and 60 min, while for samples heat treated for 90 and 120 min the formation of an additional phase of hematite (Fe$_2$O$_3$) was detected. The crystallite size (Scherrer’s equation) of a single phase structure (30, 60 min) was in the range of 13 to 16 nm. The coercive field (110 - 148 Oe) and remnant magnetization (4 – 8 emu/g) values of the samples increase as the time of heat treatment increases. This behavior is due to the fact that the heat treatment time promotes the development of structures with a high degree of crystallinity, increasing the magnetic anisotropy and restricting the movement of magnetic domains when the magnetic field is applied. From these results it is possible to conclude that a heat treatment time of 30 min is enough to promote the synthesis of magnetic nanoparticles without secondary phases. The magnetic values indicate that these synthesized samples have a ferromagnetic behavior and can be potential materials for their use in medical applications.

**Keywords:** magnetic nanoparticles, gallium-cobalt ferrites, biomedical applications

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