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Ferromagnetic, ferroelectric and magnetoelectric properties of PZT-$CoFe_2O_4$ multiferroic composite

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Abstract – The present work deals with the proccessing and characterization of the magnetoelectric multiferroic composite 50 wt. % ($PbZr_{0.45}Ti_{0.55}O_3$) + 50 wt. % $CoFe_2O_4$. The phase composition was determined by XRD and the microstructure of both the ferroelectric and ferromagnetic domains was studied by Atomic Force Microscopy (AFM). The magnetic and ferroelectric properties of the magnetic and ferroelectric phases were determined respectively with a vibrating sample magnetometer and a ferroelectric hystereograph. The magnetoelectric effect was measured by the dynamic method using a lock-in amplifier technique.

composites with high magnetoelectric constant are very important for the development of transductors and magnetic field sensors with potential applications in medicine and industry [1-4]. A suitable microstructure and composition, together with high piezoelectric and magnetostrictive constants are needed to get a high magnetoelectric effect. Cobalt ferrite is the known oxide with the highest magnetostrictive constant and the lead zirconate titanate (PZT) with composition $PbZr_{0.45}Ti_{0.55}O_3$ has a high piezoelectric constant.

In the Figure 1a) shown the morphology of the multiferroic composite PZT-$CoFe_2O_4$ where we can see the two phases PZT and the $CoFe_2O_4$, the size grain mayor correspond to $CoFe_2O_4$. As well as, the results of the X-ray diffraction that there are the phases present to the PZT tetragonal and the ferrite of cobalt (Figure (b)), On the other hand, was carried out the magnetization of the moltiferric composite PZT-$CoFe_2O_4$ with M_{max} 14438.31 emu/g and coercitive field at 307 Oe, as shown the figure 1 c). Finally was measurement the response piezoelectric by the technical piezoelectric force macroscopic in the AFM where was possible the ferroelectric domains that correspond to PZT as shown the Figure 2 b).

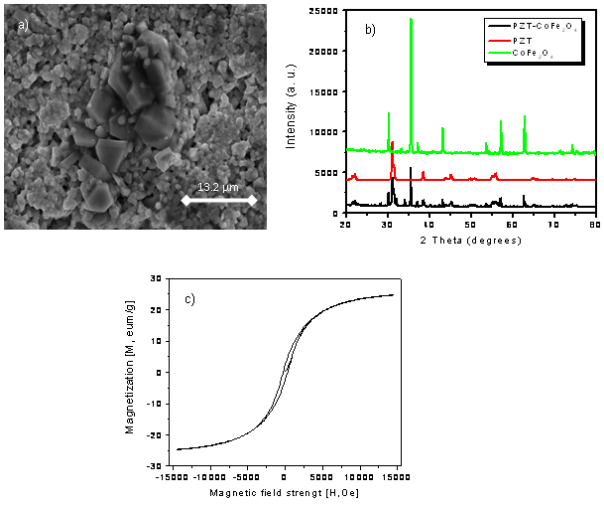

Figure 1: a) SEM micrographic of multiferroic composite PZT-$CoFe_2O_4$ **b)** Diffractograms of multiferroic, PZT and $CoFe_2O_4$ respectively **c)** Hysteresis loop curve of multiferroic (PZT-$CoFe_2O_4$)

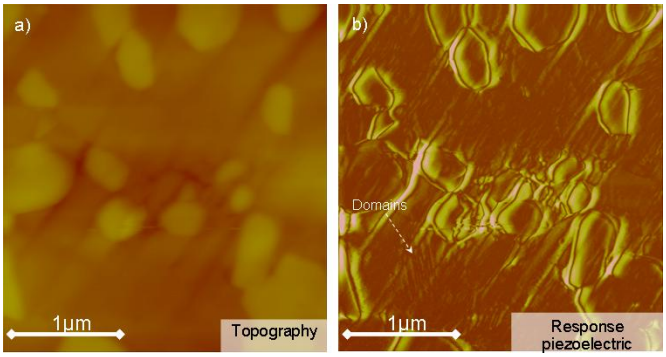

Figure 2: a) AFM topographic image of the composite mutiferroic (PZT-$CoFe_2O_4$). **b)** Response piezoelectric image of the composite PZT-$CoFe_2O_4$

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