In this work we report the epitaxial growth of CoFe$_2$O$_4$ (CFO) and Lead Zirconium Titanate (PZT) heterostructures using a pulsed laser ablation process with favorable conditions for epitaxial growth of thin films. These structures have been deposited on MgO (100) that has a close lattice match with both CFO and PZT. CoFe$_2$O$_4$ has one of the highest magnetic coercive coefficients among ferries while PZT possesses a high piezoelectric coefficient. The possible coupling between the magnetic moment and the electrical polarization in these structures that is mediated by the interfacial stress is of great interest for multifunctional devices. The epitaxial relationship between the CFO and PZT films are important to maximize the elastic interaction at the interface. Epitaxial relationship has been confirmed by the XPS and X-ray diffraction scans. The 0.1° width of the CFO(040)-PZT(200) x-ray diffraction peak measured by the rocking-curve method also indicates a high degree of epitaxy. AFM scans have been performed to measure the surface roughness of the thin films. The magnetic and electric measurements of these films and the correlation between these measurements and the structural parameters are presented.

**Surface roughness measurement**

AFM image showing 3 dimensional projection of surface topography. The film thickness is 200nm. Scan area 1µm x 1µm. The RMS value for surface roughness is 9.67nm. This is very small compared to film thickness.

**Magnetic measurement**

M vs H hysteresis loops of CFO-PZT (200nm-200nm) epitaxial bilayer on MgO substrate using PPMS measurements

Magnetic measurements show that the coercive field is larger when the magnetic field is applied in-plane than when it is applied out of plane. Thus the magnetic easy axis is out of plane.

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