Influence of Rare Earth Addition on the Structural and Magnetic Properties of Cobalt Ferrite Nanostructures

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Abstract: Cobalt ferrites are suitable materials for the development of sensors and magneto-optic devices and the substitution of iron with the rare earth (RE) ions can significantly modify the structural and consequently electric and magnetic properties of samples. The main aim of our series of studies was to analyze the influence of RE substitution, in terms of composition and type, on the properties of $CoFe_{1-x}RE_xO_4$ (RE = Gd, Dy, Yb) bulk, nanoparticles and thin films. Bulk materials were obtained by different synthesis process (classical ceramic or combustion), nanoparticles were produced mainly by coprecipitation and thin film were grown by pulsed laser deposition technique. The talk will go in deep details for the last technique, case in which an *in-situ* plasma plume analysis was done during the deposition in order to study the correlation between plasma parameters and the structural and magnetic characteristics of the obtained samples. The plasma analysis was done for all depositions by fast ICCD imaging and space and time resolved optical emission spectroscopy. The nanopowders obtained by coprecipitation were used for target synthesis at 1250^{o}C for 5 hours. The resulting disks were placed in a stainless steel vacuum chamber where a 10^{-3} Torr base pressure was ensured. The monocrystalline (100) Si substrate was placed at a distance of 5 cm in front of the target during the 60 min deposition. To reduce and even avoid the deposition of micro-sized droplets on the surface of the deposited samples, the Nd-YAG laser (532 nm) fluence was kept at 2 J/cm^2. The structural properties of nanoparticles, bulk materials and thin films were investigated by XRD, Raman spectroscopy and SEM/EDX technique which revealed the influence of the RE concentration on phase composition, lattice parameters and crystallinity. The magnetic character of the deposited samples confirmed by VSM and SQUID was strongly influenced by growth conditions.