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Combustion synthesis route of manganite type $Ca_{0.95}Eu_{0.05}MnO_{3-\delta}$: Effect of variation of urea/nitrate ratio on magnetic properties

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Abstract – Europium doped calcium manganite, $Ca_{0.95}Eu_{0.05}MnO_{3-\delta}$, was prepared by urea-nitrate combustion process. Diverse morphology and particle size were obtained according to urea/nitrate ratio. The calcined powder was found to be composed of agglomerates with relative porosity. Structural transformations were determined by the XRD method and the results revealed that the materials are tetrahedral and orthorhombic phases. Quantitative measures by Vibrating Sample Magnetometry (VSM) were obtained. The final observations proved that a correlation between urea/nitrate ratio and magnetic properties exist.

Polycrystalline structures based on perovskitic manganites which display colossal magnetoresistance (CMR) have been the subject of intense research during the last decade because of the great expectations for application of their low field magnetoresistance. The replacement of alkali metal dopant has an effect on the structural, magnetic and other physical properties [1]. Conventionally prepared alkaline-earth substituted lanthanum manganites show a very high magnetoresistance effect which is strongly linked to the presence of an optimal Mn^{4+} to Mn^{3+} ratio [2].

The aim of this work is to obtain $Ca_{0.95}Eu_{0.05}MnO_{3-\delta}$ solid solution. The process to synthesize the manganite consists in a mixture of calcium and manganese nitrates and urea. The mixture is placed in a furnace pre-heated at 600 °C where the combustion took place. In order to study the final properties of manganite, different urea/nitrate ratio was evaluated. The obtained samples are designed M-nU, with n= 1, 2, 3, 4, 5, 6, 7 and 8 that is the urea/nitrate molar ratio. The formation of mixed perovskite phase (tetrahedral and orthorhombic) has been confirmed by X-ray diffraction analysis (**Fig. 1**). SEM observations shows that the obtained material present a diminution of the primary grains and particle size when U is increased (**Fig. 2**), additionally, when the amount of fuel increases it results in a formation of a very stable and compact oxide. Finally, the manganites obtained present a paramagnetic phase at 300K, due to the regular arrangement of ions Mn^{3+} / Mn^{4+}.

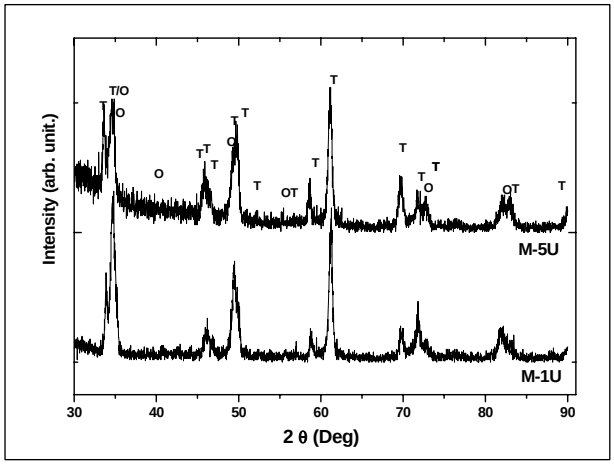

Figure 1: XRD patterns of oxide solid solution: T= tetrahedral phase, O = ortorrombic phase

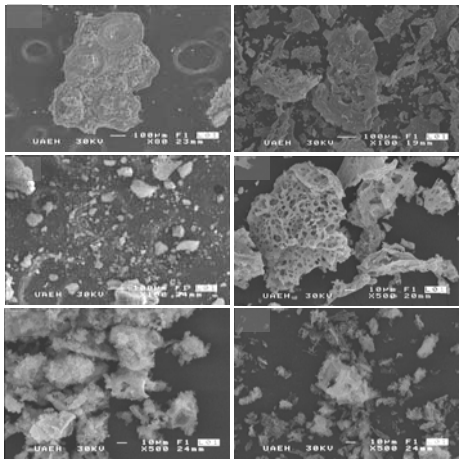

Figure 2: SEM micrographs of oxide solid solution powders prepared by combustion a) M-1U; b) M-2U; c) M-3U and d) M-4U.

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