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Structural and magnetic properties of CeO2 nanomaterials as a function of different morphologies: nanocube, nanowire and nanobelt.

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The nanomaterials of cerium oxide can be applied in catalysts, fuel cells and spintronics [1]. Additionally, in its crystalline structure, small defects named oxygen gaps appear, caused by its high potential pattern of reduction from Ce IV to Ce III or that it becomes an oxidizing agent and the conferring agent. In this work we investigated the magnetic properties of three ceria morphologies on a nanometric scale: nanocubes, nanowires and nanobelt that were synthesized using the hydrothermal method. As samples prepared from studies by using X-ray diffraction (XRD), transmission electron microscopy (TEM), magnetometry (VSM) and paramagnetic resonance (EPR). XRD measurements show characteristic peaks of ceria fluorite face-centered cubic structure. Measurements of magnetization in function of the field applied at room temperature showing the ferromagnetic character with different values of the coercive field and saturation magnetization, we observe an increase in the coercive field and saturation magnetization in ceria nanocubes that can be explained by an increase in the density of vacancy [2]. The zero field cooled (ZFC) and field cooled (FC) magnetization curves measured on low magnetic fields show a soft maximum around 60 K attributed to oxygen at the sample surface. Applying to the Curie-Weiss equation indicates the presence of antiferromagnetic interactions mainly in nanobelt and nanocubes morphologies. The EPR spectra at room temperature show two paramagnetic symmetry, with axial symmetry with $g_1 = 1.97$ and $g_2 = 1.94$ associated with Ce^{3+} and another isotropic around $g = 2.03$ due to vacancies of isolated oxygen for all samples. The ferromagnetic arrangement characterized by the presence of broad signals at about 3500 G is also observed in nanobelt morphologies.

References

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