Sol-gel prepared nanopowders of new mixed cobaltites-ferrites $DyCo_{1-x}Fe_xO_3$

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Nanocrystalline powders of mixed cobaltites-ferrites $DyCo_{1-x}Fe_xO_3$ (x = 0.3, 0.5 and 0.7) were prepared for the first time by sol-gel citrate method from Dy_2O_3, $Co(NO_3)_2 \cdot 6H_2O$ and $Fe(NO_3)_3 \cdot 9H_2O$ as initial reagents. Aqueous solutions of metal nitrates and citric acid (CA) taken in the molar ratio $n(Dy^{3+}) : n(Co^{2+}) : n(Fe^{3+}) : n(CA) = 1 : (1-x) : x : 4$ were mixed together on magnetic stirring for 30 min, gelled at 373–393 K for 4 h, after that head treated at 573 K for 1 h to obtain dry precursors. Finally as-obtained products were calcined at 1073 K for 2 h.

X-ray diffraction examinations revealed formation of pure perovskite structures isotypic with $GdFeO_3$. No traces of parasitic phases were detected. Refined values of the lattice parameters of $DyCo_{1-x}Fe_xO_3$ prove the formation of continuous solid solution with orthorhombic perovskite structure (space group *Pbnm*) in $DyCoO_3$–$DyFeO_3$ pseudobinary system. Average grain size of $DyCo_{1-x}Fe_xO_3$ powders, estimated from the analysis of XRD line broadening, was in the limit of 50–120 nm, depending on composition. Scanning electron microscopy of $DyCo_{0.7}Fe_{0.3}O_3$ sample revealed a lacy morphology of the powder consisting of irregular shaped 60–100 nm nanoparticles.

In comparison with a traditional energy- and time-consuming high-temperature solid-state synthesis of the mixed rare earth cobaltites-ferrites, required long-term sintering at 1473–1573 K with several intermediate re-grindings, the low-temperature sol-gel citrate method is a very promising tool for the production of fine powders of $RCo_{1-x}Fe_xO_3$ perovskites, free of contamination of constituent metal oxides or other parasitic phases.

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