Structural Studies of the Fe/ La_2O_3 and Fe-Cr-Ni /La_2O_3 nanocomposite obtained by mechanochemical milling.

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Rare-earth oxides as Y_2O_3 and La_2O_3 evenly dispersed in Fe matrix constitute ODS alloys with potential applications in nuclear power plants .Dispersion of the above oxides can be obtained from various synthetic routes. However, kinetics , particle size and morphology are difficult to control. Mechanochemical activation of rare earth oxide precursors with either Fe_2O_3 (hematite) or Fe_3O_4 (magnetite) was also used since diffusive processes are accelerated under ambient conditions. In the induced chemical reaction, $AFeO_3$ oxides (A is a rare earth element) can also be produced. This last orthoferrite phase is also interesting for its wide magnetic applications.

In this work, Fe/ La_2O_3 and Fe-Cr-Ni/ La_2O_3 composite powders have been fabricated by high energy ball milling. Powder mixtures were milled during different times up to 15h in a planetary ball mill where hardened steel vials were rotated at about 400 rpm under argon atmosphere and a ball to powder weight ratio of 15:1 . And phase evolution of the milled powder mixtures were analyzed during the mechanical treatment by X-ray diffraction, differential thermal analysis and scanning microscopy.

Results showed that for the Fe/10%wt. La_2O_3 composite , the hexagonal La_2O_3 oxide is unstable and coexists with $La(OH)_3$ phase probably from exposure to air. After 5h of milling , the formation of the perovskite $LaFeO_3$ is observed with the presence of nanocrystalline Fe and La_2O_3 phases. Increasing the milling time transforms the oxide phase into an amorphous structure and the iron phase into a disordered phase with a grain size less than 20 nm. Above 10 h of milling, the orthoferrite $LaFeO_3$ disappears . As for the Fe-Cr-Ni / 10%wt. La_2O_3 powder mixtures , the formation of $LaFeO_3$,$CrFeO_3$ and $NiFeO_3$ are observed after 5 h of milling. Thermal analysis showed that the formation of $LaFeO_3$ is increasing above 500°C .

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