Structural Studies of the Fe/ \( \text{La}_2\text{O}_3 \) and Fe-Cr-Ni /\( \text{La}_2\text{O}_3 \) nanocomposite obtained by mechanochemical milling.

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Rare-earth oxides as \( \text{Y}_2\text{O}_3 \) and \( \text{La}_2\text{O}_3 \) 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 \( \text{Fe}_2\text{O}_3 \) (hematite) or \( \text{Fe}_3\text{O}_4 \) (magnetite) was also used since diffusive processes are accelerated under ambient conditions. In the induced chemical reaction, AFeO\textsubscript{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/ \( \text{La}_2\text{O}_3 \) and Fe-Cr-Ni/ \( \text{La}_2\text{O}_3 \) 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. \( \text{La}_2\text{O}_3 \) composite, the hexagonal \( \text{La}_2\text{O}_3 \) oxide is unstable and coexists with \( \text{La(OH)}_3 \) phase probably from exposure to air. After 5h of milling, the formation of the perovskite \( \text{LaFeO}_3 \) is observed with the presence of nanocrystalline Fe and \( \text{La}_2\text{O}_3 \) 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 \( \text{LaFeO}_3 \) disappears. As for the Fe-Cr-Ni/ 10%wt. \( \text{La}_2\text{O}_3 \) powder mixtures, the formation of \( \text{LaFeO}_3 \),\( \text{CrFeO}_3 \) and \( \text{NiFeO}_3 \) are observed after 5 h of milling. Thermal analysis showed that the formation of \( \text{LaFeO}_3 \) is increasing above 500°C.