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MANGANESE DOPING EFFECT ON CRYSTAL STRUCTURE AND MAGNETIC PROPERTIES OF LUTETIUM FERRITE

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The combination of both magnetic and electrical properties requires significant challenges to be overcome in order to be possible. Firstly, the classically known magnetic and electric properties arise from opposite phenomena. Ferroelectric properties arise from the hybridization of empty 3d orbitals and magnetic ones require them to be partially filled. To avoid this problem other mechanisms driving ferroelectricity were discovered. They include lone pair, spin driven, geometric, and charge ordering [1]. Also, the coupling between the two is often weak. Lastly, at least one of the properties occurs at temperatures lower than room temperature. The solution to the problems is not simple or clear and in most cases is different for every material. As such the search for new multiferroic materials is still ongoing.

One potential compound is hexagonal $LuFeO_3$. Hexagonal $LuFeO_3$ is a polar compound where ferroelectricity is caused by geometric factors, mainly the displacement of Lu ions in the crystal structure [2]. The metastable structure can be stabilized by either strain during thin film preparation or by doping. Dopant effects on magnetic and electrical properties are still not clear. Even the phase formation is complicated and the stability regions of the hexagonal phase are difficult to describe as they differ for each of the dopants while also being sensitive to the preparation method and even the calcination temperature [3].

In this work we provide insights into the stabilization of hexagonal $LuFeO_3$ by Mn doping prepared by the sol-gel method. The concentration stability regions for the hexagonal phase at different calcination temperatures were described using X-ray diffraction analysis. Particle morphology was determined using SEM analysis. Lastly, we also provide additional information on the behavior of magnetic properties not only caused by the crystal structure changes but also on the effect of doping.

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