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Structural, Magnetic, and Dielectric Studies of Tetragonally Ordered $Sm_2Fe_2O_7$ Pyrochlore Nanostructures for Spintronic Application

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Abstract : Understanding the structural, electronic, and magnetic properties of nanomaterials is essential for developing next-generation electronic and spintronic devices, contributing to the progress of nanoscience and nanotechnology applications. Multiferroic materials, with intimately coupled ferroic-order parameters, are widely considered to breed fascinating physical properties and provide unique opportunities for the development of next-generation devices, like multistate non-volatile memory. In this study, we are set to investigate the structural, electronic, and magnetic properties of the frustrated Fe^{II}/Sm^{VI} sublattice in relation to the widely studied perovskites for spintronics applications. The atomic composition, microstructure, crystallography, magnetization, thermal, and dielectric properties of a pyrochlore $Sm_2Fe_2O_7$ system synthesized using sol-gel methods are currently being investigated. Precursor powders were dissolved in citric acid monohydrate to obtain a solution. The obtained solution was stirred and heated using a magnetic stirrer to obtain the gel phase. Then, the gel was dried at 200°C to remove water and organic compounds and form an orange powder. The X-ray diffraction analysis confirms that the structure crystallized as a pyrochlore structure with a tetragonal F4mm (107) symmetry. The presence of Fe^{3+}/Fe^{4+} mixed states is also revealed by XPS analysis.

Keywords : nanostructures, multiferroic materials, pyrochlores, spintronics
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