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Investigations on Spintronic $RFeO_3$ Crystals Grown by Optical Floating Zone Technique

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Magnetic materials are in great demand for magnetic devices such as memory, sensing, and communication applications. Magnetic crystals are physically important to know their intrinsic magnetic properties. Magnetic crystals are also technologically important and their creation has aided crystal growth significantly. Rare-earth orthoferrites material ($RFeO_3$) is one of the major components used in manufacturing sophisticated gadgets. This study focuses on the growth and physical properties of the optically generated $RFeO_3$ (R = Y, Gd and Sm) single crystals. The floating zone method generates single crystals of 3-20 mm/h in the optical zone. The purity of the grown materials was confirmed from the Powder X-Ray Diffraction (PXRD) analysis. The addition of Gd to $YFeO_3$ increases the lattice parameters of the material. Magnetic properties of the grown crystal were studied between 20-700 K. At high temperature, two anomalous effects were observed, one at (T_{SR} = 480 K) due to spin reorientation and the other is antiferromagnetic (AFM) to paramagnetic transitions at (T_N = 670 K). Bloch parameter was also calculated. Microhardness value decreases nonlinearly. When the applied load is greater than 1.96 N, there is a transition from palmqvist to median crack due to the plastic deformation of the crystal. Controllable magnetic and mechanical characteristics will help to enhance performance of magnetic devices.

Keywords : Rare-earth Orthoferrites; Optical floating zone; Magnetic properties; Hardness.