Structural and Magnetic Properties of $DyCrTiO_5$ Nanoparticles

B. Bharati,[1,2] P. Mohanty,[2] C.J. Sheppard,[2] and A.R.E. Prinsloo[2]

[1] *Spectrum Analytical Centre, Faculty of Science, University of Johannesburg, PO Box 524, Johannesburg 2006, South Africa*

[2] *Department of Physics, University of Johannesburg, P.O. Box 524, Johannesburg 2006, South Africa*

Futuristic engineering science is searching for advanced magnetic materials with novel properties such as magnetization reversal (MR), magnetocaloric effect (MCE), spin switching (SS), and spin reorientation (SR) [1]. The compounds with the general chemical formula $R\mathrm{CrTiO_5}$ (R = rare-earth ions) crystallize in an orthorhombic structure with space group *Pbam*, isostructural to the $R\mathrm{Mn_2O_5}$ [1-3]. The interesting magnetic behavior observed in $R\mathrm{CrTiO_5}$ compounds is attributed to the presence of two magnetic sublattices [1-3]. However, there are very few reports on the physical properties of these compounds, and are primarily on bulk. From this family of compounds, $DyCrTiO_5$ is one of the most interesting materials to study because of the large magnetic moment of Dy as well as large magnetocrystalline anisotropy of $DyCrTiO_5$ [1]. Das *et al.* [1] discussed the magnetic properties of $DyCrTiO_5$ bulk samples that showed novel features, such as MR, SR, and exchange bias phenomenon because of the interaction between R^{3+} and Cr^{3+} [1]. The exploration of structural and magnetic properties of $R\mathrm{CrTiO_5}$ compounds in the nano dimension has not been reported to date. This report focuses on the synthesis of DyCrTiO nanoparticles using a simple and cost-effective sol-gel technique to explore the role of size on structural and magnetic properties. Subsequent calcination of the synthesized samples at 800 °C led to single phase particles. The crystal structure is confirmed from the Le-Bail profile fitting [1] of the x-ray diffraction (XRD) pattern. The $DyCrTiO_5$ nanoparticles crystallized in an orthorhombic structure having lattice parameters, a, b, c of 7.32, 8.64, 5.84 Å, respectively. The average particle size obtained from the transmission electron microscopy (TEM) is around 75 nm which is in line with the size estimated from the XRD using Scherrer equation. From the temperature-dependent magnetization measurement at 50 Oe magnetic field, the obtained T_N value is around 151 K. In contrast to the bulk form, $DyCrTiO_5$ nanoparticles do not show SR which should be observed below 37 K or the magnetic compensation [1]. In addition, the magnetization is suppressed when measured as a function of temperature with a probing field 50 Oe in the heating cycle of measurement. The observed anomalous properties are discussed considering the size effect.

References:

[1] Das *et al.* J. Phys.: Condens. Matter. **32**, 035802 (2020)
[2] Das *et al.* Phys. Rev. B **98**, 104420 (2018)
[3] Basu *et al.* Phys. Rev. B **96**, 184431(2017).

Authors acknowledge financial support of SANRF and UJ.