

NEUTRON DIFFRACTION STUDY OF STRUCTURAL DISTORTIONS AND MAGNETIC STRUCTURE OF Bi-Sm-Fe-Ti-O MULTIFERROIC

V.V. Sikolenko¹, V.V. Efimov¹, R. Lanovsky², N. Tereshko², A. Sazonov³ and
D.V. Karpinsky^{2,4}

¹ *Joint Institute for Nuclear Research, Dubna, Russia*

² *SSPA “Scientific-Practical Materials Research Centre of NAS of Belarus”, Minsk, Belarus*

³ *European Spallation Source, Lund, Sweden*

⁴ *National Research University of Electronic Technology MIET, Moscow, Russia*

E-mail: vadim.sikolenko@jinr.int

We present the results of investigation the structural and magnetic properties of multiferroic $\text{Bi}_{1-x}\text{Sm}_x\text{Fe}_{0.94}\text{Ti}_{0.06}\text{O}_3$ perovskites with compositions within the morphotropic phase boundary ($x = 0.1$ and 0.12). The combination of high-resolution neutron powder diffraction with complementary techniques has provided deeper insight into the temperature- and composition-dependent evolution and local distortions in the coexisting *R3c* and *Pbam* phases in the 1.5 to 300 K temperature range, and their correlation with the emergence of weak ferromagnetism and exchange bias effects. Our results demonstrate that the temperature-dependent magnetic response, including the enhancement of weak ferromagnetism and emergence of exchange bias at low temperatures for both samples, cannot be attributed to variations in the volume fractions of the structural phases, which remain nearly constant over the considered temperature range, specifically nearly 37/63 and 50/50 *Pbam*-to-*R3c* phase ratios for the $x = 0.1$ and $x = 0.12$, respectively. Instead, the key factor is the temperature-dependent evolution of the structural parameters within the orthorhombic *Pbam* phase, particularly the tilting, rotation, and distortion of FeO_6 octahedra. These distortions, accompanied by the complex dynamic of overlapped Fe^{3+} d- and O^{2-} p-orbitals due to the changes in Fe – O - Fe bond angles, directly affect the magnetic exchange interactions, enhance spin canting via increased Dzyaloshinskii-Moriya interactions, resulting in enhancement of weak ferromagnetism and complex magnetization behavior.