Structure, ferromagnetism and ferroelectricity of nanocomposite multiferroic

Multiferroics belong to multifunctional materials which show great application potential in high-performance information storage and processing, magnetoelectric and spintronic devices [1-4]. One of the crucial problems is to obtain a strong magnetoelectric coupling therein.

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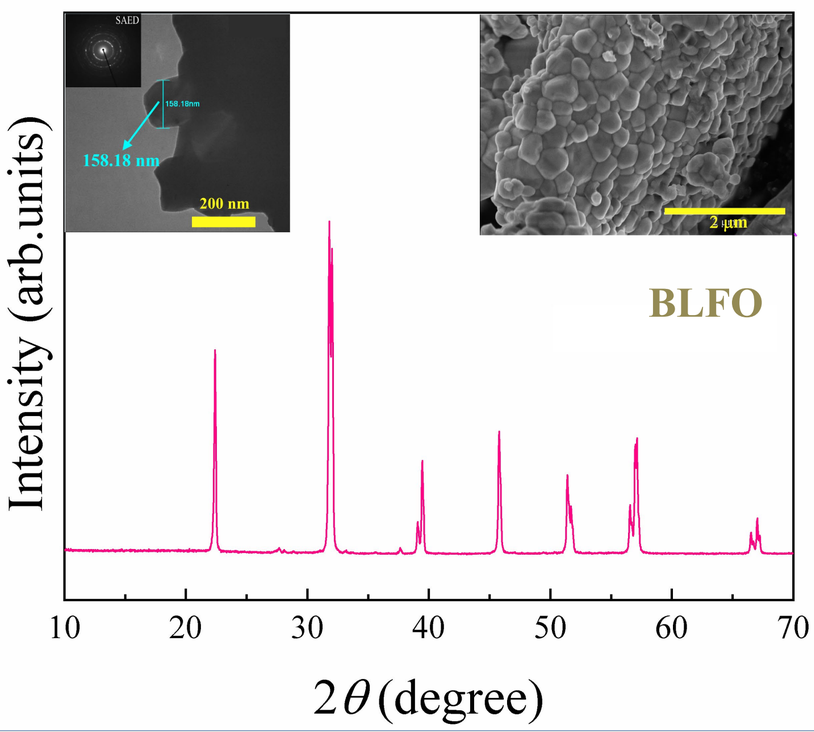
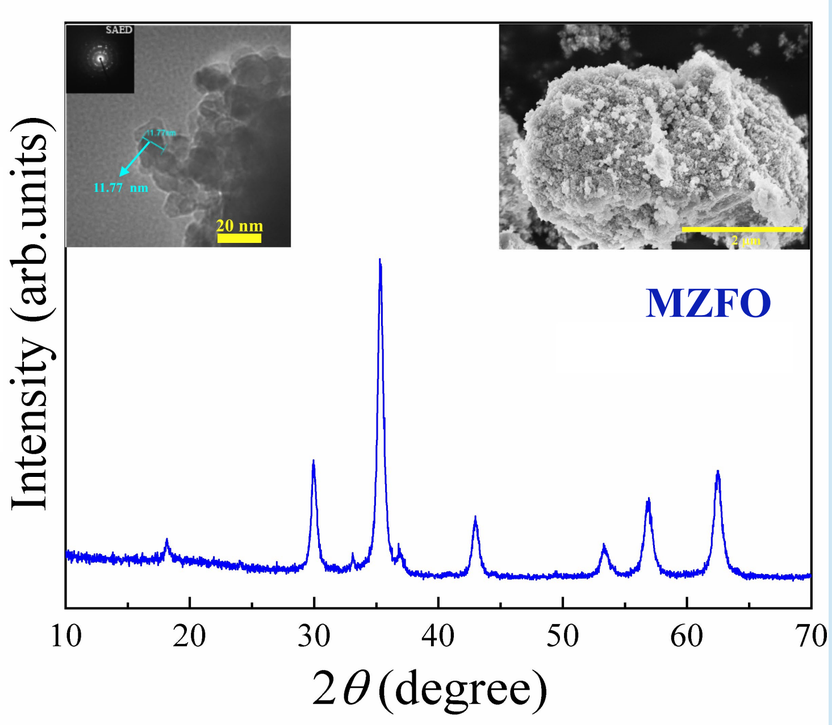
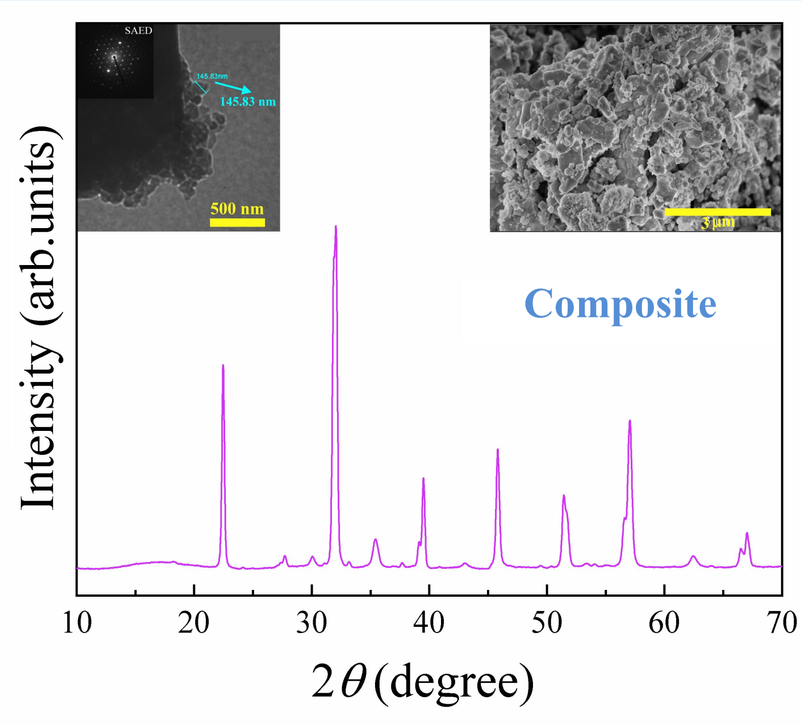
Methods of Investigation

- X-ray diffraction (XRD) method using Shimadzu LabX XRD-6000 diffractometer in $Cu_{K\alpha1}$-radiation (λ = 0.15418 nm) at room temperature
- Transition electron microscopy (TEM) method using JEM-2200FS Transmission Electron Microscope
- Scanning electron microscopy (SEM) and Energy Dispersive Spectroscopy (EDS) methods using FEI Magellan 400
- Magnetic method using LDJ-9500 magnetometer at room temperature *T* = 300 K
- Ferroelectric method using Precision Multiferroic II analyzer equipped by charge-based magnetoelectric response tester

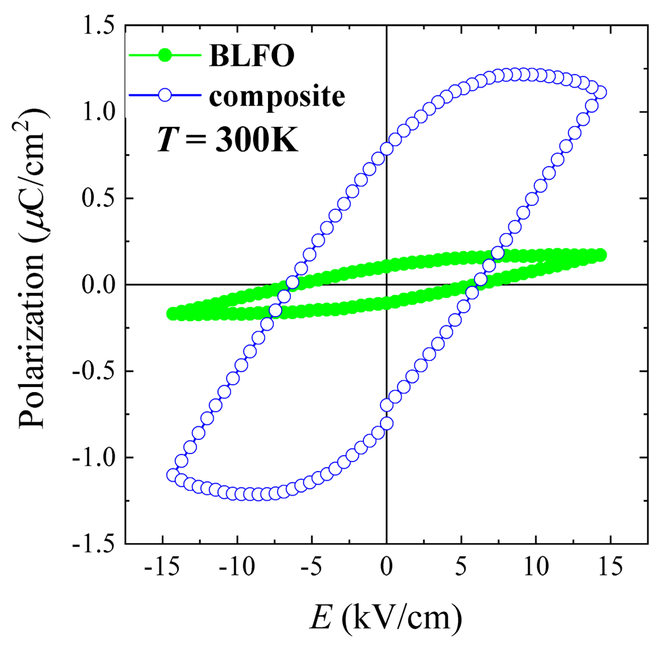
Results and Discussion

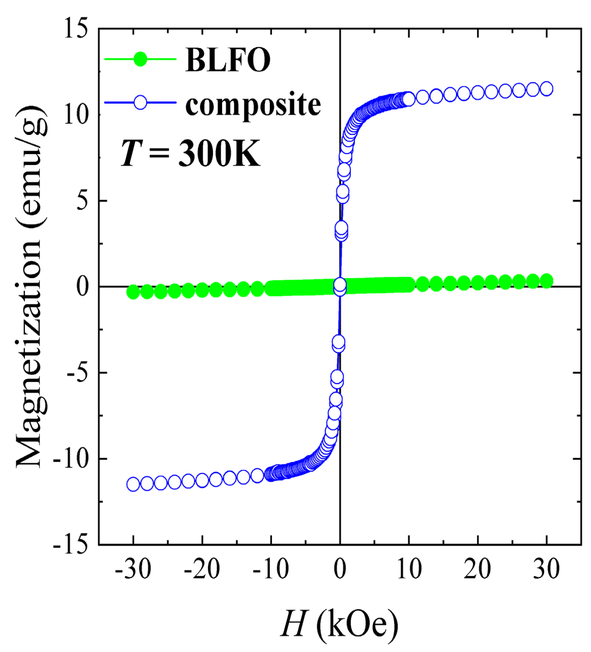


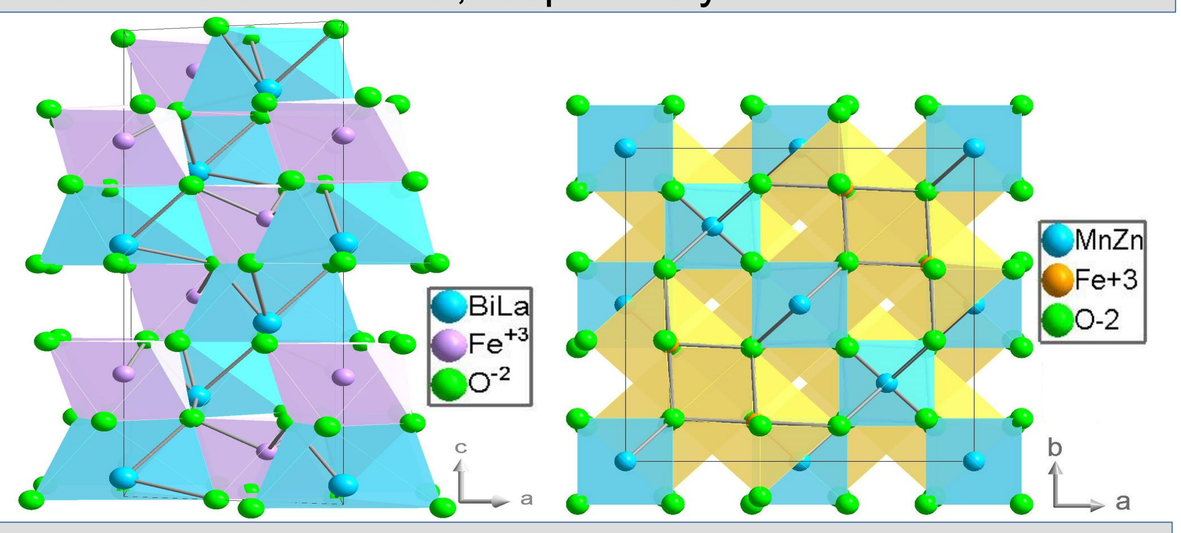




According to XRD, SEM and TEM data, it has been found that 0.8BLFO-0.2MZFO composite is a combination of multiferroic $Bi_{0.9}La_{0.1}FeO_3$ (BLFO) rhombohedral polar *R3c* and ferromagnetic $Mn_{0.6}Zn_{0.3}Fe_{2.1}O_4$ (MZFO) cubic ferrospinel *Fd3m* fractions, an average particle size of which is 160 and 12 nm for BLFO and MZNO, respectively.







Dilution of BLFO multiferroic by high-permeability MZFO leads to an increase in both electric polarization and magnetization at room temperature.

Conclusions

- Multiferroic BLFO demonstrates rhombohedral polar *R3c* perovskite structure with an average particle size of 160 nm.
- Ferromagnetic MZFO exhibits cubic *Fd3m* spinel structure with an average particle size of 12 nm.
- The 0.8BLFO-0.2MZFO nanocomposite combining multiferroic BLFO and ferromagnetic MZFO phases retains their structures.
- Implementation of high-permeability MZFO ferrospinel in composite improves ferroelectric and ferromagnetic properties and, as a consequence, magnetoelectric coupling.
- The obtained results expands new possibilities for using such multiferroic-based composites in weak magnetic and electric fields.

References

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