Title: Static and Dynamic Magnetoelectric Coupling in Multiferroics

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Abstract:

This thesis explores the multiferroic properties and magnetoelectric coupling in different compounds. The first study investigates $BiMn_3Cr_4O_{12}$, where the ferroelectric transition induces an antiferromagnetic phase. The ferroelectric critical temperature corresponds to the Néel temperature below which the Cr^{3+} spins exhibit G-type antiferromagnetic order, and an increase in ferroelectric polarization is observed at the second Néel temperature of the Mn^{3+} spins, indicating enhanced magnetoelectric coupling. In the second study, the focus is on $BiMn_7O_{12}$ ceramics, revealing two structural phase transitions above room temperature related to ferroelectricity. Dielectric anomalies and Raman spectroscopy support the presence of static magnetoelectric coupling at the low-temperature magnetic phase transitions. The third study examines the effects of Mn^{3+} substitution with Fe^{3+} in $TbMnO_3$. Different mechanisms for static and dynamic magnetoelectric coupling are observed, along with electromagnon and crystal-field excitations coupled to polar phonons. The correlation between static magnetoelectric coupling and magnetic structure in $TbMn_{0.98}Fe_{0.02}O_3$ under magnetic fields is investigated, highlighting the tunability and impact of cationic substitution on magnetic structures and magnetoelectric responses. Overall, this thesis offers valuable insights into ferroelectric phase transitions, spin-phonon interactions, and the influence of cationic substitution on the static and dynamic magnetoelectric coupling.

Keywords: Multiferroics, Ferroelectrics, Soft-modes, Electromagnons, Perovskites.