Single-phase and single-ion displacive-type manganese perovskite multiferroics

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Coincident ferroelectric and magnetic orderings are intensely investigated due to anticipated applications in advanced spin-based electronics. Single-phase multiferroics (MF) are rare because origins of the two orders are almost mutually exclusive. Recently, in addition to the well known $BiFeO_3$, new MF transition metal oxides have been discovered: the Fe-based perovskite compounds with very small tolerance factors and the hexagonal $R(Mn,Fe)O_3$. Ferroelectricity results from the off-centering of the R-ion in its oxygen cage while the AFM is induced in the Fe/Mn-O lattice for both systems. More recently tilt engineering have been used in layered perovskites to generate ferroelectricity without requiring zone-center displacements. Our research on Ti-substituted $Sr_{1-x}Ba_xMnO_3$ perovskites with large tolerance factor show MF originating exclusively from the displacive-type distortions of magnetic Mn^{4+} in MnO_6 at T_F up to 420 K exceeding the temperature and size of Ti^{4+} distortions in archetypal $BaTiO_3$. The G-type AFM order below 200 K dramatically suppresses distortions showing that order parameters are strongly coupled.