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$A_3TeX_3Z_2O_{14}$ (A=Ba, Pb, K; X=Co, Mn, Fe; Z=V, P): Understanding symmetry loss in langasites

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$Ba_3NbFe_3Si_2O_{14}$ (BNFS) is a langasite that displays simultaneous antiferromagnetic ordering and ferroelectric polarization below T_N = 26 K. But many langasites, including BNFS, crystallize in the nonpyroelectric space group P321. It has been postulated that ferroelectric domains in BNFS and related systems may arise from either the Dzyaloshinskii-Moriya interaction or through symmetry loss to either the P3 or C2 (or lower) space groups from magnetoelastic distortions. Indirect experimental evidence for symmetry loss to C2 exists, but such a distortion is too small to detect with synchrotron X-ray diffraction and implies polarization along the wrong axis. Here, we present another route to understanding symmetry loss in langasites. Rather than focusing on BNFS, where the observed small structural distortions are clouded by experimental uncertainties, we instead turn our attention to alternative chemical systems that are more prone to structural distortions. Unlike BNFS, these distortions can be directly detected using X-ray diffraction. In particular, emphasis is placed on Pb-containing langasites that distort away from P321 symmetry and the impact of this symmetry loss on the magnetism observed in each system.

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