Atomic Structure of Pyrochlore Bismuth Zinc Niobate Thin Films

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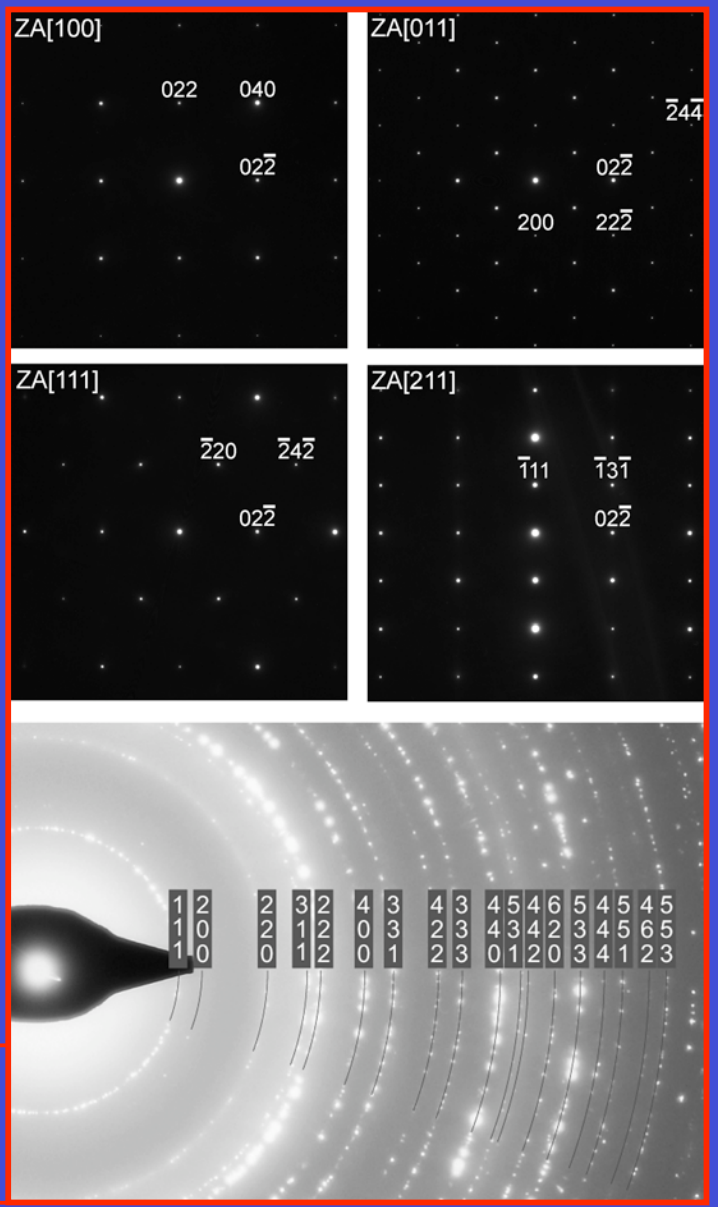
The unusual dielectric properties of pyrochlore bismuth zinc niobate (BZN), in particular its low dielectric loss, high dielectric constant and electric field tunability are believed to be closely related to the displacive and chemical disorder within the unit cell.

$Bi_2Ti_2O_7$ (BTO) has the cubic pyrochlore structure with disordered displacements of both the Bi and O' sites, similar to bismuth zinc niobate. This makes BTO a model material for understanding structure-property relationships in bismuth pyrochlore dielectrics. In contrast to BZN, however, BTO is not a thermodynamically stable phase.

In this study we demonstrated the synthesis of nearly phase-pure BTO with the cubic pyrochlore structure using a thin film process. Its dielectric properties were distinctly different from BZN. The study showed that in addition to structural disorder, chemical disorder (present in BZN but not in BTO) is essential for achieving high room temperature dielectric constants and tunabilities in bismuth based pyrochlores.



Electron diffraction patterns of the $Bi_2Ti_2O_7$ films confirming that the films were pyrochlore phase (not stable in bulk form) and the presence of 244 reflections due to the off-centering of A-site cations.