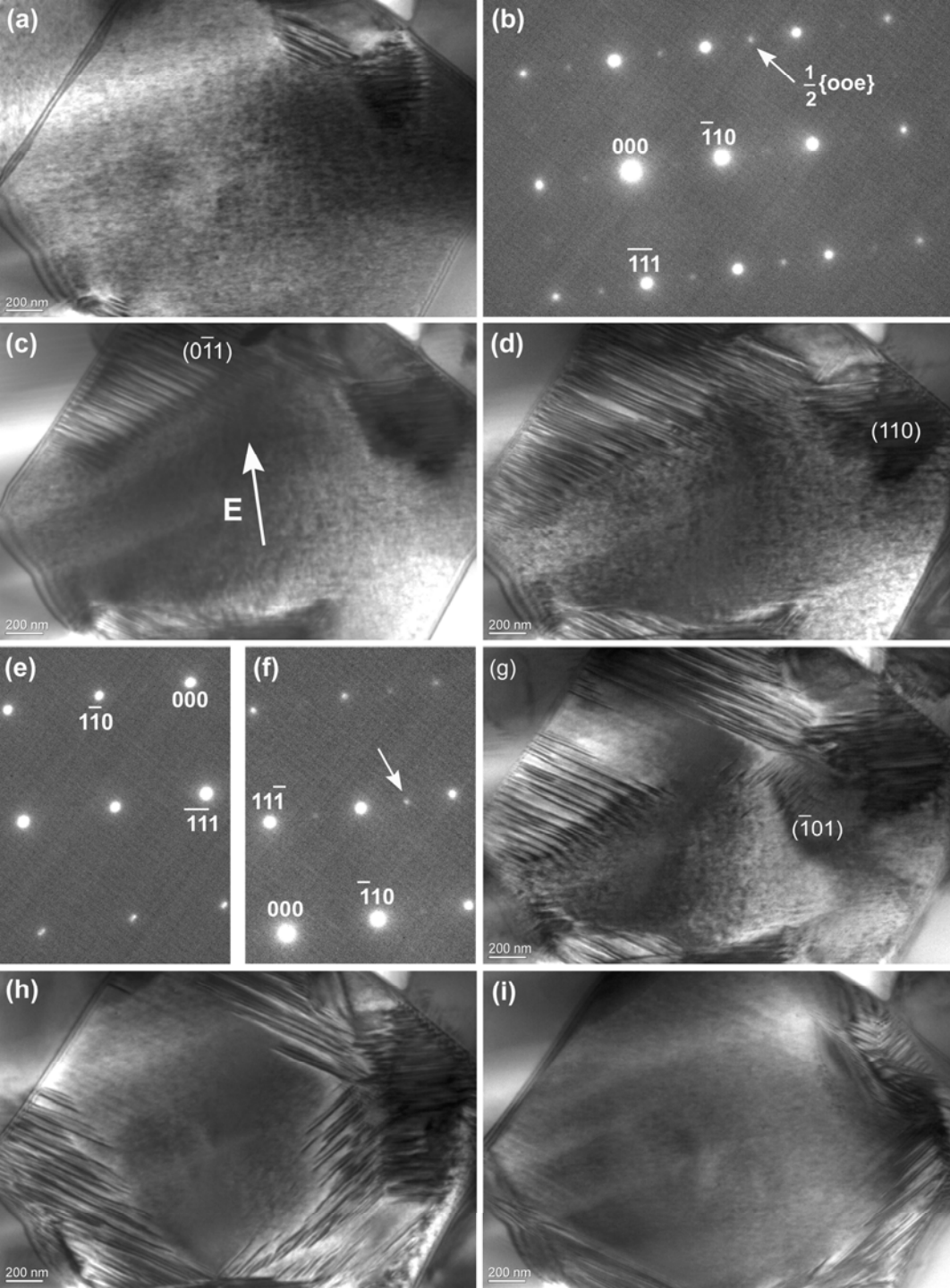


Origin of the Electric Field-Induced Strain in Lead-Free Piezoelectric Ceramics

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$\text{Pb}(\text{Zr}_{1-x}\text{Ti}_x)\text{O}_3$ has been the most widely used solid solution system for piezoelectric ceramics. However, their high content (>60 wt.%) of Pb has raised serious health and environmental concerns. Intensive worldwide search for Pb-free replacements has identified the $(1-x)(\text{Bi}_{1/2}\text{Na}_{1/2})\text{TiO}_3-x\text{BaTiO}_3$ binary solid solution as one of the most promising systems. Despite of extensive previous researches, the origin of the strain developed under electric fields is still unclear. With our unique *in situ* TEM technique, we revealed the electric field induced phase transition at the nanometer scale in real time for the first time in these Pb-free compositions.



(a) & (b) 0 kV/cm; (c) 5 kV/cm; (d), (e) & (f) 7.5 kV/cm; (g) 10 kV/cm; (h) 12.5 kV/cm; (i) 25 kV/cm.