New Ferro-/Piezoelectric and Antiferroelectric Materials of Complex Perovskite Structure

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The design and discovery of novel materials are pivotal in advancing technology, particularly within the realm of multifunctional materials that exhibit unique dielectric, piezoelectric, ferroelectric, and antiferroelectric properties. These materials are in high demand for a wide range of applications, including sensors, actuators, transducers, and capacitors. This talk focuses on the crystal chemistry, synthesis, and characterization of new piezoelectric, ferroelectric, and antiferroelectric materials with complex perovskite structures.

Firstly, to design piezoelectric and ferroelectric materials suitable for high-temperature electromechanical transduction applications, a series of bismuth-based ferro-/piezoelectric single crystals with high Curie temperatures have been grown, including $Bi(Zn_{1/2}Ti_{1/2})O_3$-$PbTiO_3$, $Bi(Zn_{2/3}Nb_{1/3})O_3$-$PbTiO_3$ and $BiScO_3$-$PbTiO_3$. The crystal structures, as well as their dielectric, ferroelectric, and piezoelectric properties, are characterized. Additionally, the mesoscopic and nanoscopic ferroelectric/ferroelastic domain structures are discussed.

Secondly, to develop materials for dielectric energy storage and actuator applications, high-quality $PbHfO_3$-based antiferroelectric ceramics have been prepared using the solid-state reaction method with a liquid phase sintering mechanism. The crystal structure, microstructure, phase transitions, energy storage, and electric field-induced strain performance are systematically investigated.