Time-resolved structure-property relationships in piezoelectric ceramics

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Piezoelectric materials enable conversion of electrical and mechanical energy and are used pervasively as sensors, actuators, and vibrational energy harvesting devices.

Investigators at the University of Florida have developed new approaches using X-ray and neutron scattering to determine the physical origins of this mechanical-electrical energy conversion.

Conventional wisdom suggests that small atomic displacements (the intrinsic piezoelectric effect) contribute primarily to the strongest electromechanical conversion in these materials. However, the present new measurements indicate that entire reorientation of atomic positions through the motion of atomic defects (domain walls) give rise to the strongest electromechanical coupling.

These measurements suggest new and necessary ways to design materials for new electromechanical applications, for example lead(Pb)-free materials for bio-friendly applications or high-temperature sensors and actuators for aerospace.