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The Kinetics of Polarization Switching and Electromechanical Coupling in Bulk Ferroelectric Ceramics

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Ferroelectric materials are electroactive materials with wide applications ranging from ultrasonic transducer and sensor technology to data storage. These materials show a permanent polarization that undergoes spontaneous reversal under large applied electrical or mechanical fields. For the first time, we aim at a quantitative insight into polarization switching using macroscopic in-situ measurements and microstructural evolution. Using an in-house experimental technique named Broadband Electromechanical Spectroscopy we apply large electrical fields to millimeter-scale samples while measuring polarization evolution, mechanical strain fields and viscoelastic properties in-situ. We will present results on rate-dependent polarization switching in two types of ferroelectric ceramics, lead zirconate titanate and barium titanate. We will also discuss ongoing investigations to understand the underlying microstructural kinetics of ferroelectric domains using a combination of experimental probes and modeling.