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Ferroelectric relaxor properties characterized by dynamic mechanical analyses

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Relaxation makes ferroelectrics a critical component in sensors, actuators and ultrasound devices, with large electromechanical coupling effects. Although various studies of ferroelectric relaxation have been undertaken, much remains to be investigated regarding the related the electric properties and mechanisms. In this study, an alternative mechanical method using a dynamic mechanical analyzer (DMA) was applied to investigate the low frequency relaxor behavior of ferroelectric PZT and $BaTiO_3$ ceramics, compared with conventional electric method. Ferroelectric to paraelectric phase transitions were clearly detected and an obvious low frequency relaxor behavior was characterized, induced by Debye relaxation. The activation energy of each relaxation peak and relaxation limit time was theoretically analyzed using the Arrhenius relationship.

The DMA is suited for characterizing low frequency relaxor behavior of ferroelectrics, it is sensitive to internal structural changes. In contrast, no low frequency relaxor behavior was detected by dielectric measurements. This study deepened the current knowledge on relaxor ferroelectrics, and offered the potential for provide new insights into the investigation of low frequency relaxor characterization.