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Elektrische Ermüdung in Funktionswerkstoffen

TECHNISCHE UNIVERSITÄT DARMSTADT

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Transitions of Domains and Phases in $(Bi_{1/2}Na_{1/2})TiO_3$–$BaTiO_3$ Ceramics Driven by Composition, Temperature, and E-Field

The structure-property relationship in the unpoled (1-*x*)$(Bi_{1/2}Na_{1/2})TiO_3$–*x*$BaTiO_3$ ceramics was studied using transmission electron microscopy (TEM) and dielectric characterization. In contrast to the reported phase diagrams determined using poled ceramics, an additional phase region exhibiting *P4bm* nanodomains was revealed at room temperature around the *x* = 0.06 morphotropic phase boundary, where optimal properties are obtained. In combination with dielectric characterizations, the hot-stage and room-temperature TEM study suggest an excellent structure-property correlation below 250 ºC. The *P4bm* nanodomains are associated with the "relaxor antiferroelectric" behavior, which is a new concept proposed in this study to describe the unique short-range-ordered antiferroelectric behavior, while large ferroelectric domains give rise to long-range-ordered ferroelectric behaviors. In contrast to the sharpness of the corresponding dielectric anomaly, the structural transition between large ferroelectric domains and *P4bm* nanodomains occurs gradually in a temperature range of several tens of degrees. The results are summarized as an updated phase diagram for unpoled (1-*x*)$(Bi_{1/2}Na_{1/2})TiO_3$–*x*$BaTiO_3$ ceramics.
The 0.93$(Bi_{1/2}Na_{1/2})TiO_3$–0.07$BaTiO_3$ ceramic was further investigated with the E-field *in situ* TEM technique. The transition of the nanodomains of the relaxor antiferroelectric *P4bm* phase to the lamellar microdomains of the ferroelectric *P4mm* phase was revealed for the first time. When the applied field increased further, the coalescence of lamellar microdomains into a huge *P4mm* domain was also recorded. Our results directly confirmed the occurrence of an E-field induced phase transition during the poling process in morphotropic phase boundary compositions of the (1-*x*)$(Bi_{1/2}Na_{1/2})TiO_3$–*x*$BaTiO_3$ lead-free piezoceramics.

Die Vortrag findet um **16:00 Uhr** im Gebäude der Materialwissenschaften, Lichtwiese, Petersenstr. 23, **Raum 128** statt