

Phenomenological model of dielectric properties for PMN-PT

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Abstract

© 2017 Taylor & Francis Group, LLC. The temperature behavior of the dielectric properties of PMN-PT has been considered in the framework of phenomenological theory of phase transitions in the systems with defects. The results are presented for the region of the diffuse phase transition, where dynamics of the charge localization on defects affects the dielectric properties. The consideration has been performed on the basis of simple thermodynamic ideas.

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Keywords

phase transitions, phenomenological theory, Relaxors

References

- [1] G. A., Smolenskii, V. A., Isupov, A. I., Agranovskaya, S. N., Popov, Ferroelectrics with a diffuse phase transition. *Sov Phys Solid State*. 2, 2584–2596 (1961).
- [2] L. E., Cross, Relaxor ferroelectrics. *Ferroelectrics*. 76, 241–267 (1987).
- [3] W., Kleemann, Random-field induced antiferromagnetic, ferroelectric and structural domain states. *Int J Mod Phys B*. 7, 2469–2507 (1993).
- [4] N., Setter, L. E., Cross, The role of B-site cation disorder in diffuse phase transition behavior of perovskite ferroelectrics. *J Appl Phys*. 51, 4353–4360 (1980).
- [5] Z., Levstik, A., Kutnjak, C., Filipic, R., Pirc, Glassy freezing in relaxor ferroelectric lead magnesium niobate. *Phys Rev B*. 57, 11204–11211 (1998).
- [6] A. E., Glazounov, A. K., Tagantsev, Phenomenological model of dynamic nonlinear response of relaxor ferroelectrics. *Phys Rev Lett*. 85, 2192–2195 (2000).
- [7] E. V., Colla, E. Yu., Koroleva, N. M., Okuneva, S. B., Vakhrushev, Long-time relaxation of the dielectric response in lead magnoniobate. *Phys Rev Lett*. 74, 16811684 (1995).
- [8] J., Macutkevic, J., Banys, A., Bussmann-Holder, A. R., Bishop, Origin of polar nanoregions in relaxor ferroelectrics: Nonlinearity, discrete breather formation, and charge transfer. *Phys Rev B*. 83, 184301 (2011).
- [9] G. G., Guzman-Verri, P. B., Littlewood, C. M., Varma, Paraelectric and ferroelectric states in a model for relaxor ferroelectrics. *Phys Rev B*. 88, 134106 (2013).
- [10] S., Prosandeev, I. P., Raevski, M. A., Malitskaya, S. I., Raevskaya, H., Chen, C-C, Chou, B., Dkhil, Condensation of the atomic relaxation vibrations in lead-magnesium-niobate at $T=T^*$. *J Appl Phys*. 114, 124103 (2013).
- [11] A., Al-Barakaty, S., Prosandeev, D., Wang, B., Dkhil, L., Bellaiche, Finite-temperature properties of the relaxor PbMgNbO from atomistic simulations. *Phys Rev B*. 91, 214117 (2015).
- [12] A. P., Levanyuk, V. V., Osipov, A. S., Sigov, A. A., Sobyenin, Change of defect structure and the resultant anomalies in the properties of substances near phase-transition points. *Sov Phys JETP*. 49, 176–188 (1979).
- [13] N. I., Lebedev, A. P., Levanyuk, A. S., Sigov, Polarized defects and anomalies in the properties of crystals at phase transitions. *Sov Phys JETP*. 58, 825–832 (1983).

- [14] R. F., Mamin, Effect of thermal filling of trapping centers on the stability of structural phases in semiconductors. JETP Lett. 58, 538-541 (1993).
- [15] R. F., Mamin, R., Blinc, Time delay in the low-temperature phase of relaxors. Phys Solid State. 45, 942-945 (2003).
- [16] V. V., Shvartsman, A. L., Kholkin, I. P., Raevski, S. I., Raevskaya, F. I., Savenko, A. S., Emelyanov, Macroscopic and local piezoelectric properties of PbMgNbO-PbTiO single crystals exhibiting giant piezoelectric response. J Appl Phys. 113, 187208 (2013).
- [17] S. I., Raevskaya, Yu. N., Zakharov, A. G., Lutokhin, A. S., Emelyanov, I. P., Raevski, M. S., Panchelyuga, V. V., Titov, S. A., Prosandeev, Critical nature of the giant field-induced pyroelectric response in Pb(MgNb)OPbTiO single crystals. Appl Phys Lett. 93, 042903 (2008).
- [18] A. S., Emelyanov, S. I., Raevskaya, F. I., Savenko, V. Yu., Topolov, I. P., Raevski, A. V., Turik, A. L., Kholkin, Dielectric and piezoelectric properties of (001)-oriented (1-x) Pb(MgNb)O-xPbTiO single crystals with $0.1 \leq x \leq 0.4$. Sol State Commun. 144, 188-192 (2007).
- [19] I. P., Raevski, S. A., Prosandeev, A. S., Emelyanov, S. I., Raevskaya, E. V., Colla, D., Viehland, W., Kleemann, S. B., Vakhrushev, J-L, Dellis, M. E. I., Marssi, L., Jastrabik, Bias-field effect on the temperature anomalies of dielectric permittivity in PbMgNbO-PbTiO single crystals. Phys Rev B. 72, 184104 (2005).
- [20] R. F., Mamin, T. S., Shaposhnikova, Appearance of the relaxor behavior. JETP Lett. 101, 27-31 (2015).