Wide-range dielectric spectroscopy of $BaTiO_3$-based nanoceramics and various nanocomposites

Jan Petzelt, Dmitry Nuzhnyy, Tetyana Ostapchuk, Premysl Vanek, Viktor Bovtun, Maxim Savinov

Institute of Physics, Acad. Sci. Czech Rep.

e-mail: petzelt@fzu.cz

New data on dielectric spectroscopy and critical dynamics of pure $BaTiO_3$ (BT) crystals [1], ceramics and nanoceramics [2] are briefly reviewed, including the dielectric grain-size effect on the permittivity and its frequency dispersion up to the infrared range [3].

In addition, various BT core - dielectric nano-shell composites were studied in a similar frequency range and modeled by appropriate models based on effective medium approximation (EMA) [4-6]. An unexpected strong dielectric dispersion was revealed below the THz frequency range in all sufficiently dense samples, not obtained by modeling using EMA. We assign it to partial interdiffusion of BT into the shells. The dispersion is presumably connected with bound charges present in these gradient layers, which create a strong interfacial polarization [6].

Another type of nanoconfined BT was obtained by infiltration of BT sol into the nanoporous Vycor and opal silica glasses [7]. It was shown that in the pores of 4-6 nm diameter (Vycor), BT remains amorphous, but with ferroelectrically distorted TiO_6 octahedra. In larger pores of opals (up to ~50 nm) partial crystallization of BT occurs without macroscopic percolation, but displaying a diffuse ferroelectric transition.

The work was supported by the Czech Science Foundation (project 202/09/0430).

References

1. J. Hlinka, T. Ostapchuk, D. Nuzhnyy, J. Petzelt, P. Kuzel, C. Kadlec, P. Vanek, I. Ponomareva, L. Bellaiche, Phys. Rev. Lett. **101**, 167402 (2008).
2. T. Ostapchuk, J. Petzelt, M. Savinov, V. Buscaglia, L. Mitoseriu, Phase Transitions **79**, 361 (2006).
3. J. Petzelt, Ferroelectrics **400,** 117 (2010).
4. D. Nuzhnyy, J. Petzelt, I. Rychetsky, V. Buscaglia, M. T. Buscaglia, P. Nanni, J. Phys. D **42** 155408 (2009).
5. J. Petzelt, Proc. Appl. Ceram.**3**, 145 (2009).
6. D. Nuzhnyy, J. Petzelt, V. Bovtun, M. Kempa, M. Savinov, C. Elissalde, U.-C. Chung. D. Michau, C. Estournes, M. Maglione, submitted to J. Adv. Dielectrics.
7. D. Nuzhnyy, P. Vanek, J. Petzelt, V. Bovtun, M. Kempa, I. Gregora, M. Savinov, R. Krupkova, V. Studnicka, J. Bursik, M. I. Samoylovich, W. Schranz, Proc. Appl. Ceram., **4**, 215 (2010).