

Frontiers in the research on voltage-tunable materials

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Voltage-tunable materials are marked by a distinctive dependence of the dielectric constant on the DC-bias field, which is determined by the relative tunability parameter ($n_r = (\varepsilon(0) - \varepsilon(E)) / \varepsilon(0)$). These materials play a major role in communication systems, as phase shifters, tunable filters, tunable capacitors, etc. The investigations of tunable materials have been focused mainly on paraelectric modifications near ferroelectric transitions of a displacive type, in particular on $(\text{Ba}_{1-x}\text{Sr}_x)\text{TiO}_3$ -based compounds. However, their high losses, dielectric constant and the temperature dependence of the dielectric constant limit their use, leading us to investigate novel materials. We focused our investigation on ferroelectrics of the relaxor type, in particular on $\text{Na}_{0.5}\text{Bi}_{0.5}\text{TiO}_3$. The temperatures of the $\text{Na}_{0.5}\text{Bi}_{0.5}\text{TiO}_3$ phase transitions and thus the intensities of the dielectric relaxations were modified by the addition of various ferroelectric and antiferroelectric incipient-type compounds. The samples that we prepared exhibited improved voltage-tunable characteristics, especially for higher additive concentrations. We determined that this improvement relates to the low-temperature dielectric relaxations and to the dynamics of nanosized polar regions. In the contribution the voltage-tunable characteristics of the obtained materials will be correlated with their microstructure, stoichiometry and polar order.

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