Influence of depolarizing fields and screening effects on phase transitions in ferroelectric composites

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The general increase in the requirements for functional opportunities of different devices has sharply increased the demands for their elemental base. Natural materials no longer satisfy the growing technological and operational requirements due to the limited range of operating parameters, randomness of their characteristics and the absence of opportunities for changing functional parameters. Artificial nanomaterials with controlled properties, based on the influence of nanoscale effects on the properties of materials, one of them is ferroelectric nanocomposites, fit better for these purposes. An important characteristic for practical application of these materials is temperature range, where ferroelectric properties are observed in the researched composites. Factors reducing their Curie point TC are the correlation effects as well as the depolarizing fields arising near the surface of the ferroelectric inclusions. The present work calculates depolarizing fields arising near the boundaries of a spherical ferroelectric inclusion in an isotropic dielectric environment and evaluates the effect of these fields, and screening effects on the Curie point in the composites. The studies of depolarizing field effects on the transition temperature in ferroelectric composites, with spherical ferroelectric inclusions embedded in the dielectric matrix, demonstrate that, in the absence of screening effects, the decrease of the Curie point in composites compared with bulk materials is determined by the ratio of the ferroelectric inclusion Curie constant to the permittivity of the matrix. The TC shift in these composites with screening is reduced by multiplying the above value by a decreasing factor equal to the ratio of the screening length to the radius of the ferroelectric inclusion. The authors suppose that the example of such material can be a composite of nanocrystalline cellulose with ferroelectric sodium nitrite, for which the Curie point is displaced approximately 40 degrees lower on the temperature scale relative to bulk sodium nitrite. Another demonstration of depolarizing fields and screening effects' influence is the behavior of the mixture composite triglycine sulfate and silica.

Speaker Biography

Alexander Sidorkin, doctor of physical and mathematical sciences, professor of the department of experimental Physics, Voronezh State University, Russia. He is the author of over 200 scientific works, including several books. A.S. Sidorkin is a head of several scientific grants, participant of numerous scientific conferences, member of Scientific Council of Russian Academy of Sciences on Dielectric and Ferroelectrics, Honored Worker of Higher Professional Education of the Russian Federation.

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