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On Numerical Simulations of Composite Dielectrics in Thermally Stimulated Conditions

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Abstract: A binary composite system with particulated inclusions was considered. First, thermally stimulated depolarization ({\sc tsd}) currents of the system were simulated by altering different parameters of the {\sc tsd} current equation, {\em i.e.}, intrinsic dielectric properties of constituents, conductivity of inclusions, heating rate and activation energy of inclusion conductivity and shape of inclusions. Two different methods of finding the activation energy of {\sc tsd} processes from the simulated {\sc tsd} currents were discussed. Second, we have included the Monte Carlo technique by assuming that the shape factor of inclusions were distributed. These simulations have shown that if the inclusions were distorted spheres, the resulting {\sc tsd} currents were identical. Finally, since the classical calculations have neglected the inclusion-inclusion interactions, the finite element method ({\sc fem}) was used to include the influence of local fields (mutual interaction of inclusions). The dielectric responses of two-dimensional systems at isothermal conditions were calculated by the {\sc fem}, and later, the {\sc tsd} currents were estimated with the {\sc fem} results by assuming a constant activation energy for the relaxation processes. The comparison of the obtained results has shown that the influence of micro-structure and mutual interaction of particles should be included in the modeling considerations.

Key Words: Dielectrics, composite materials, thermally stimulated depolarization current.

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