Complex permittivity of dispersed systems with penetrable particle-host interphase

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We present a model for study of the effect of particle-host interphase on the effective complex permittivity of finely dispersed systems. The model is based upon the method of compact groups of inhomogeneities [1,2], which allows one to take into account the contributions from many-particle polarization and correlation effects and to use different ways of homogenization of the system. In particular, the well-known Maxwell-Garnett and Bruggeman mixing rules are readily recovered in the limiting cases of complete asymmetry and complete symmetry between the system's constituents.

Within the model, the interphase phenomena are approached by modeling the geometric structure and the permittivity profile of the dispersed particles and the host. We analyze in detail the case where the particles are spherical and consist of hard cores surrounded by outer shells. The latter are allowed to overlap. The total volume of the overlapping regions is found using the Monte Carlo simulations [3] for the porosity of such a system.

Based on our results for the complex permittivity of the above system, we have also established: the conditions favoring the percolation-type behavior of the conductivity, accompanied by a considerable increase of the real part of the effective permittivity; the percolation threshold and the critical index of the conductivity as functions of the parameters of the model.

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