

Abstract

Influence of Concentration Fluctuation on mv Properties of Composites

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Recently, there has been reborn the interest to metal-dielectric mixtures. First of all this is a demand of modern industry that requires mv materials with high values of the real part of permittivity and low dissipation. The materials prepossess by the simplicity of their manufacturing and machine processing.

The theoretical background is the percolation theory that predicts high values of dielectric constant without dissipation just below the percolation threshold. It is really true at zero frequency but at high frequencies there appear the Maxwell currents which connect separate conducting clusters and cause dissipation. Unfortunately, the dissipation observed in practice significantly exceeds the percolation theory prediction. Usually, the effect is withdrawn on the contacts since there is no reliable information of them. It is shown that the skin effect is responsible for observed dissipation. It is well known that the skin effect on a separate metal inclusion (skin effect of the first kind) shifts the dissipation line into low comparing with conductivity of the metal frequency band. If we deal with the system the concentration of which is near but below percolation threshold then even small concentration deviation in some volume can bring the volume just above percolation threshold. The skinning of the fields at the volume (the skin effect of the second kind) shift the dissipation line resulting in its broadening and significant increase of the dissipation at frequencies just below undisturbed line. It is worth emphasizing that in opposite to skin effect of the first kind which results in renormalization of metal conductivity only the skin effect of the second kind is an example of the system where the Bergman-Milton spectral theory should fail due to solenoidal nature of fields which do not governed by the Laplace equation.

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