

POLYMER-CERAMIC COMPOSITES AS MATERIALS WITH REQUIRED COMPLEX PERMITTIVITY

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Many applications in microelectronics and microwave power engineering rely on dielectrics with particular dielectric properties [1-3]. This paper outlines an original approach to production of materials with required complex permittivity. The technique is based on an inverted power-law mixing rule model computing volume fractions in which three or more prime materials should be taken to get in the resulting homogeneous mixture the required dielectric properties. Functionality of the approach is demonstrated by production of composites from a polymer matrix (polymethyl methacrylate) and two inorganic fillers (silicon and alumina). The composites are made by mechanically mixing the powders and axially hot-pressing and cooling the mixture. Complex permittivity of the samples is measured by a split-post resonator method. Experimental data on dielectric properties of the samples help calibrate the technique; for the used powders, the Looyenga power-law model (a.k.a. the Landau-Lifshitz model) with the power 1/3 is found to be most adequate. In the produced samples, the target values of dielectric constant are reached with a higher precision than the ones of the loss factor; however, analysis of the production process and error propagation in the computations suggest that deviations of the resultant complex permittivity fall in the anticipated ranges. Features and issues of both computational and production parts of the technique are finally discussed.

References

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