Abstracts

Microwave Measurement of Dielectric Properties of Low-Loss Materials by the Dielectric Rod Resonator Method

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Improvements both in accuracy and speed are described for the technique of measuring the microwave dielectric properties of low-loss materials by using a dielectric rod resonator short-circuited at both ends by two parallel conducting plates. A technique for measuring the effective surface resistance R/sub s/ of the conducting plates is proposed to allow the accurate measurement of the loss tangent tan delta. By means of the first-order approximation, the expressions are analytically derived for estimating the errors of the measured values of relative permittivity epsilon/sub r/, tan delta, and R/sub r/, for measuring the temperature coefficient of epsilon/sub r/, and for determining the required size of the conducting plates. Computer-aided measurements are realized by using these expressions. It is shown that the temperature dependence of R/sub s/, should be considered in the tan delta measurement. The copper plates used in this experiment have the relative conductivity of 91.0±2.7 percent at 20°C, estimated from the measured R/sub s/ value. For a 99.9-percent alumina ceramic rod sample, the results measured at 7.69 GHz and 25°C show that epsilon/sub r/= 9.687±0.003 and tan delta = (1.6±0.2) x 10/sup -5/. The temperature coefficients measured between 25 and 100°C are 112x10/sup -6//°C for epsilon/sub r/, and 23x10/sup -4//°C for tan delta.

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