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Accuracy Improvement of an Existing Permittivity Measurement Technique for Dielectric Disk Samples

A method for permittivity measurement is re-studied. Though being able to determine the dielectric constant of disk samples, it suffers from frequency variation that can lead to errors as severe as 20% at certain frequencies. A technique that improves the accuracy is proposed here. It capitalizes on trends in the slopes of retrieved permittivity vs. frequency graphs to sieve out the undesired frequency dependence. These slope phenomena are characterized via numerical simulations of the measurement structure, which comprises a dielectric disk sample sandwiched between disjointed inner conductors of a coaxial cavity. Read-up data graphs for general usage are then obtained. Repetitive generation of such graphs is thus not necessary. With error levels of less than 1%, the accuracy of this improved method is significantly higher than that obtained by just directly applying the original technique alone. Being independent of the required reference materials, the method is also shown to be stable. In addition, an independently new technique for measuring the permittivity of annular ring samples using quadratic curve fitting is proposed. By measuring only three known materials (one of them may be free space, thus reducing only to two required known solid dielectrics), the permittivity of any unknown dielectric may subsequently be determined with high accuracy over a wide frequency range. Comparison results of accuracy between this new approach and the improved method mentioned earlier will be presented.