Abstracts

Characterization of Highly Dispersive Materials Using Composite Coaxial Cells: Electromagnetic Analysis and Wideband Measurement

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In this work, theoretical modeling and experimental characterization of composite coaxial-line cells are made for accurate dielectric measurement. The coaxial cells are designed such that highly dispersive materials can be characterized over a wide band of frequencies. In addition, a transmission line matrix (TLM) algorithm with a new type of node is proposed for electromagnetic analysis of the complex composite geometry of the measurement cells. Such a hybrid-mode simulation allows the electrical performance of the proposed cells to be determined for a variety of complex permittivity measurements. The proposed node in the cylindrical coordinate not only accommodates cylindrical coaxial discontinuities in the cell, but also describes the frequency-dependent properties of material. Experiments on a network analyzer were done with a number of APC-7 coaxial cells and various liquid samples to verify the wideband characteristics of the technique. It is found both theoretically and experimentally that the sample volume can be adjusted to ensure a wideband sensibility of the S-parameters. A sensitivity factor is also defined to characterize the frequency response of the coaxial cells. Such an electromagnetic analysis (direct problem) can be used in extracting unknown dielectric characteristics of a material (inverse problem) based on a recently proposed generic approach.

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