Abstracts

9-GHz Complex Permittivity Measurements of High-Loss Liquids Using a Variable-Length Reflection Cavity and a Dual-Channel, Double Superheterodyne Signal Processing System

H.A. Buckmaster, T.H.T. Van Kalleveen, H. Zaghloul and C.H. Hansen. "9-GHz Complex Permittivity Measurements of High-Loss Liquids Using a Variable-Length Reflection Cavity and a Dual-Channel, Double Superheterodyne Signal Processing System." 1987 Transactions on Microwave Theory and Techniques 35.10 (Oct. 1987 [T-MTT]): 909-916.

This paper evaluates those factors which limit the accuracy with which microwave complex permittivity measurements of high-loss liquids can be made using a variable-length reflection sample cell spectrometer. Measurements made at 0.001-in increments from a cell length of 0.11 into 0.31 in were found to be statistically independent of the reflector diameter in the interval 0.5 in to 4.25 in. The data were analyzed using expressions for the amplitude and phase derived assuming a plane wave model. It is found that the permittivity epsilon' and the loss epsilon'' can be determined typically to a precision of 0.3 percent and 0.5 percent, respectively, using a 9.354-GHz dual-channel, double superheterodyne signal processing system. However, there is a discrepancy of about two standard deviations between the values of epsilon' and epsilon'' obtained from the phase data and those obtained from the amplitude data. Moreover, it is also found that the values of epsilon' and epsilon'' caculated from these data differ by more than three standard deviations from those obtained using a variable-length transmission sample cell and the same signal processing system. These discrepancies, which exceed 1 percent are attributed to deficiencies in the plane wave model. It has been confirmed using 0.011 and 0.051 mol l/sup -1/ KCl solutions that the sensitivity achievable with the reflection cell is less by a factor of 100 than that with a transmission sample cell, which is in agreement with the estimated precision obtainable with these two different types of sample cells.

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