

Analysis of Cylindrical Coplanar Waveguides (CCPW) for Dielectric Measurements

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The propagation of electromagnetic waves in a loaded waveguide is influenced by the configuration of the waveguide and by the dielectric properties of the materials in contact with it (S.S Stuchly and C.E. Bassey, *Meas. Sci. Technol.* 9, 1324-1328, 1998). Cylindrical coplanar waveguides (CCPW) are increasingly being used as antennas and sensors in microwave applications due to their unique characteristics which include design flexibility, and their ability to fit over curved surfaces. We present a numerical analysis of the propagation characteristics of electromagnetic waves in single-layer and multi-layer CCPW. The objective of this work is to examine the feasibility of using CCPWs as sensors for measuring dielectric properties of materials.

Computations were carried out using MATLAB codes and design equations obtained by conformal mapping and quasi-static methods (M. Alkan et al., *Int. J RF and Microwave CAE*, 8: 303-314, 1998). Numerical analysis indicates that the characteristics were somewhat similar to those of planar coplanar waveguides. Results show that the characteristic impedance of a loaded cylindrical waveguide is inversely related to the effective dielectric constant, in agreement with previous studies (V. Akan and E. Yazgan, *Microwave and Opt. Tech Lett.* Vol. 42, 317-322, 2004). Also, the phase velocity is affected by the permittivity of the material surrounding the waveguide. Additionally, it is shown that the CCPW is sensitive to the thickness of the material surrounding it. These results indicate that the CCPW presents a suitable structure to determine dielectric properties of materials. The configuration is compatible with microwave integrated circuits and is suitable for measurements on curved surfaces. This work enhances the utilization of cylindrical coplanar waveguides as sensors for measuring dielectric properties of materials.

This presentation focuses on the design, analysis, and applications of CCPW in dielectric measurements.