

Open-Waveguide Dielectric Measurements using Complementary Frequency Selective Surfaces (CFSS)

Chinwe C. Njoku⁽¹⁾, Shiyu Zhang⁽¹⁾, William G. Whittow⁽¹⁾, and J. (Yiannis) C. Vardaxoglou^{*(1)}

(1) School of Electronic, Electrical & Systems Engineering, Loughborough University, LE11 3TU, UK

For the accurate characterization of the dielectric properties of substrates used in electromagnetic (EM) applications, robust techniques have been developed including plane-wave illumination, waveguides and resonators to meet this requirement. In previous work, the authors introduced a Waveguide-Resonator method; the resonator is the CFSS – complementary frequency selective surfaces, for dielectric constant measurements (C.C. Njoku et al., *Proc. EuCAP*, 2420-2422, 2013). Examining the resonant frequency, quality (Q) factor and insertion loss differences of the CFSS with and without the material under test (MUT), the permittivity and loss tangent of the MUT can be calculated. This method required the MUT cut to the WG aperture size and placed next to the CFSS within the WG in a closed environment. This paper examines the use of an open WG with one end covered by the CFSS and the sample placed over the WG flange to fully cover the aperture. Whilst the Q is low, this technique is versatile and low cost.

The main advantage of this method is that it reduces the need to accurately machine the MUT to the WG aperture size and is shown in Fig. 1(a). Another useful feature is that it allows for quick estimation of the dielectric constants of materials. By measuring several dielectrics of various thicknesses and known/previously characterized EM properties, a lookup table of results can be built as shown in Fig. 1(b); estimated dielectric constant values of new MUTs are then easily read off this table.

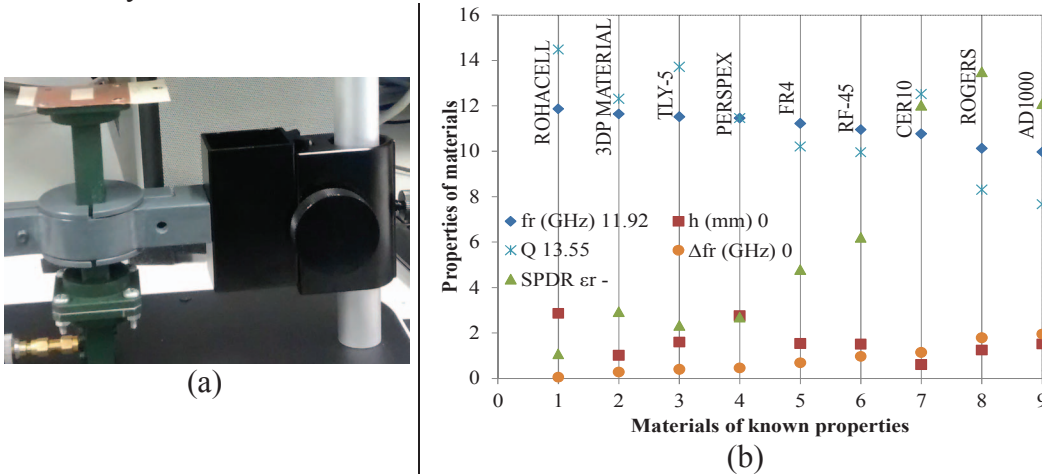


Figure 1: (a) Open waveguide and CFSS for dielectric waveguide measurement. (b) Initial measured results

The paper will discuss further results will be presented on other MUTs tested and how the gap between the WG flanges affects the accuracy of the extracted results.