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Numerical simulation of small transverse displacements of an inhomogeneous dielectric plate

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Numerical simulation is carried out of small transverse displacements of an inhomogeneous dielectric plate relative to a near-field multiple mode microwave probe based on a square waveguide filled with Teflon with a coaxial waveguide placed inside. The probe dimensions and the operating frequency range are selected so that TEM, TE10 and TE01 modes can propagate in the space between the walls of the square waveguide and the screen of the coaxial one. A metal screen with a subwavelength hole is provided at one of the ends of the square waveguide. Numerical methods have been used to study the interaction of a probe with a dielectric plate with a model metal square located on it. The conversion coefficients of the main TEM mode into TE10 and TE01 modes are obtained depending on the displacement of the plate with inhomogeneity relative to the probe in the plane of the square. The values of the mode conversion coefficients obtained during the calculation are up to -30 dB and are sufficient to detect them by measuring instruments. The proposed design can be used to measure small transverse displacements with an accuracy of about 1–2 % of the wavelength (0.3 mm for a frequency of 20 GHz (wavelength of 15 cm)).

Keywords: near-field microwave sensing, square coaxial waveguide.

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