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Compact Broad-Band Admittance Tunnel incorporating Gaussian Beam Antennas and Low-Diffraction Iris

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Intellectual Property Status

Patent pending

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Background

Microwaves have a wide use in telecommunications, radar, semiconductor, industrial and biological applications. Hence, a precise knowledge of the microwave properties of materials is critical for efficient design and operation of microwave systems. In the measurement of dielectric and magneto-dielectric constitutive properties of lossy materials, an admittance tunnel is usually setup. This apparatus is used to characterize the materials for absorption of electromagnetic energy. In a typical application, large areas of the material interact with the incident wave. Hence, it is desirable that the properties of the test material measured represent the overall average properties. However, manufacturing inhomogeneties in the material may result in significant errors. Therefore, methods like microscopic profiling and other destructive testing methods are not desirable. Hence, there exists a need for a method to measure the material properties in a small region under plane wave incidence condition.

Invention Description

Researchers at Arizona State University have developed a technique for measuring the dielectric and magneto-dielectric properties of materials. A layered dielectric poly-rod is coupled to a broadband double ridged waveguide horn to provide an efficient approximation of plane wave incidence condition onto a material sample in a compact domain. This poly-rod horn antenna and the low diffraction iris developed are compatible with the industry standard data-reduction algorithms and provide an accurate approximation of plane wave incidence.

The design of the antenna allows efficient coupling of the input signal into a TM dielectric slab surface wave mode and release it to obtain a Gaussian Electromagnetic field profile at the output. The technique can be used to measure material samples of areas from 1 foot X 1 foot up to 3 feet X 3 feet and thickness ranging from 0.002 inches to 6 inches. This technique also eliminates the errors due to echo from ridge termination and reflection of the electromagnetic radiation.

Potential Applications

- Useful in the telecommunication industry to test the performance of materials
- Better design of domestic appliances such as microwave ovens
- Efficient design of remote sensing, defense and space equipments
- Useful in semiconductor processing techniques that use microwaves

Benefits and Advantages

- Accurate modeling of plane wave conditions in a small region
- Generates smooth and consistent results
- Offers a simple to implement and an economical design
- Works in a wide range of frequency 0.7 GHz to 20.0 GHz
- Enhanced signal to noise ratio
- Versatile to use with different antenna types and diffraction control techniques