**MEASUREMENT AND CALCULATION OF THE EFFECTIVE DIELECTRIC PROPERTIES FOR PARTIALLY HOLLOW, STRUCTURED GEOMETRIES**

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When processing materials using microwave technology, it has become common place to use models to design the best possible cavities and to create fundamental understanding of the process. The accuracy of these models can be highly dependent on the accuracy and precision of the dielectric data available, especially when working with low loss materials. This problem can be compounded by the use of engineered materials, whose composite structure is partially made of air. In addition, when the structure is anisotropic (a continuous network in one direction, but not in others), it can be expected that there will be anisotropic dielectric properties. When these materials are subjected to a microwave field, especially in single mode cavities, a good fundamental understanding of the effect is required to successfully model systems with accuracy.

When using materials that contain a significant amount of empty space, a common approach to obtaining a rough estimation of the dielectric properties is done by using simple weighted averages by volume of the dense material and the air space. This method does not always produce the required accuracy, especially for materials that are not dominated by one medium or the other.

This paper examines the many theories available, including the applicability of Maxwell–Garnet approximations, Bruggeman’s effective medium theory, Jonscher’s modifications, and the more recent numerical solutions available through the use of intensive computing. These theories will be compared with experimentally derived dielectric properties. There is also a discussion of scattering and refraction due to the effect of the wavelength vs. the size of the material and air pockets or channels.