Abstracts

Microwave characterization of 2-D random materials: numerical simulations and experiments

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It is difficult to know what sample dimension allows us to characterize a heterogeneous material in the microwave range. To this end, in this paper, we emphasize the role of characteristic homogenization sizes for the determination of effective medium properties. We have performed a Monte Carlo (MC) numerical simulation of the reflection coefficient of a two-dimensional (2-D) plane composed of randomly distributed nonmagnetic conducting sticks. This method consists of determining the scattered field by integrating Maxwell's equations on a periodic realization of the plane, obtained by randomly dropping d sticks (per unit surface) on a square of side T periodically repeated in the plane. We show that the reflection coefficient strongly depends on the length introduced for the homogenization of this medium and tends to a steady value beyond a characteristic homogenization length T. We consider only the case where there is no current from one stick to another; in other words, there are only isolated sticks. After demonstrating the existence of a minimum homogenization size T/sub c/, beyond which this sample can be considered as "homogenizable", we define an intrinsic parameter called the "square impedance", Measurements in the frequency range of 2-18 GHz have been carried out in free space in a broad-band lens focusing facility. Numerical results have been compared to the effective medium theory (EMT) results and validated by measurements.

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