ANALYSIS OF BROADBAND ABSORBING MAGNETIC MATERIALS

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ABSTRACT

Coating of conducting bodies with thin layers of magnetic materials is used to reduce the reflection and back scattering from the bodies. The concept of transmission line is used to design such Wave Absorbing Magnetic Materials (WAMMs). These WAMMs are made of several dielectric layers, usually on top of a conducting plane. The total absorption of the electromagnetic energy is done in the last layer. Other layers are used to match the wave impedance of the WAMM to that of the incidence media for the normal incidence only and at different microwave frequencies. The approach is easy, practical and flexible, allowing the design of WAMM for specific applications such as Radar Absorbing Materials (RAMs) and Wireless Local Area Networks (WLANs). A wide range of frequencies is considered to maintain a minimum range of reflection.

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CHAPTER 1

1. INTRODUCTION

1.1 General

The characterization of absorbing materials is of great interest in a number of microwave and millimeter wave applications. Examples include reduction of clutter due to multipath reflection from buildings and structures, minimization of radiation patterns perturbations due to coupling between antennas and their enviroment. Pitman et. al [1] mentioned that an exact mathematical description of the reflection loss performance of an absorptive material of known thickness on a metal structure requires only the four terms of complex magnetic permeability ($\mu = \mu' - j\mu''$) and dielectric permittivity ($\varepsilon = \varepsilon' - j\varepsilon''$) of the component materials. One version of an ideal absorber might comprise a single, thin layer of material having numerically equal values of complex permeability and permittivity and high loss tangents (μ''/μ' and $\varepsilon''/\varepsilon'$) over a wide range of frequencies. The former ensures efficient matching of the incident wave into the absorber, and the latter promotes rapid attenuation thereafter. In respect to electrical properties, materials may be divided into two broad classes: conductor and insulators (dielectrics). Conductors carry appreaciable currents even under fairly weak electric fields. Dielectrics on the other hand, permit only extremely small currents under quite high fields. Wave Absorbing Material (WAM's) are designed using a lossy dielectric in the form of pyramids, mounted side by side and contacted at the base, forming a continuous slab of lossy dielectrics. The reason behind this design is to make a gradual transition from the wave