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METAMATERIAL ABSORBER (MMA) IN X-BAND, FOR STEALTH APPLICATIONS

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Stealth and Radar Absorbing materials play important role in several applications including Defense. Such applications require a certain type of coating or paint or film to absorb the incoming electromagnetic (EM) radiation. To achieve stealth at certain band of frequencies, reflection coefficient has to be minimized which essentially means there has to be perfect impedance matching between the incoming wave and material used. Therefore, both complex permittivity (ϵ_r) ($\epsilon_r=\epsilon' + i\epsilon''$) and complex permeability ($\mu_r = \mu' + i\mu''$) of the material plays important role in stealth applications. Electromagnetic Metamaterials (MMs) are artificial materials which are, effectively homogeneous, periodic structures with unusual electromagnetic and material properties not readily available in nature. The constitutive electromagnetic parameters (electric permittivity ε and magnetic permeability μ) of such materials depend on the nature of the unit cell and are essentially uniform along the direction of propagation [1]. Recently, Metamaterial Absorbers (MMAs) have attracted wide interest among researchers due to their exotic properties and possibilities. Since the first prefect MMA was proposed in 2008, many researchers have proposed different topologies and methodologies to produce high absorption of electromagnetic energy. This has been possible by eliminating the reflection and transmission of electromagnetic radiation and by realizing the absorption due to the electrical and magnetic resonances engineered to coincide at the same frequency and the absorption in the intervening dielectric substrate [2]. These MMAs have been engineered to operate at specific frequency spectrum ranging from microwave to ultraviolet. They can be single band, multiband, broadband, polarization insensitive and wide angle [3].

The present paper is aimed at investigating reduction of Radar Cross Section (RCS) by use of periodic metamaterial (MM) structures in X-Band. Simulations for different MM designs have been done using Microwave Studio (MWS) by Computer Simulation Technology (CST). The simulations have been performed for structures on two different substrates, FR4 and polyamide. In some initial designs it was observed that the absorption at one frequency was of the order of 57 % which was further improved with design changes to 100%. It was also observed that the structures made were independent of the polarization and direction of the incoming waves which is very important characteristics for Radar Absorbing Material. However, attempts to increase the bandwidth of absorption lead to the reduction in the power absorbed. The maximum absorption obtained for the optimized design was upto -58.5 dB for a -10 dB bandwidth of 50 MHz at 10.222 GHz. Some preliminary results in which the scaled down layers of multilayers were created and absorption above 70% at multiple frequencies was obtained. The results are found to be encouraging and further work can be useful for the development of reliable RAM coatings.

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