Abstract

Electromagnetic (EM) absorbers, nowadays, are used throughout the frequency spectrum. Some of the important applications of todays absorbers include radar signature reduction of targets, electromagnetic compatibility (EMC), etc. at microwave range; sensor, detector, spatial light modulator, bolometer, solar cell, etc. at Infra-red (IR) and visible range. In view of suitability for modern applications, this thesis presents the design and analysis techniques of efficient planar electromagnetic absorbers. With the help of impedance analysis method, it is shown that ultrathin absorber can be realized by using conductive frequency selective surface (FSS) on the top of a grounded lossy dielectric substrate. Following that, a conductive square ring-based ultrathin absorber is designed. The unit cell of the ring-based absorber is miniaturized and its absorption level is improved by incorporating Giuseppe Peano fractal. The bandwidth of this inherently narrowband ultrathin absorber is enhanced by multiplexing the fractal-modified rings with closely spaced resonances in a unit cell. Moreover, the phenomenon of cross-polarized reflection from the EM absorbers is characterized. A technique is presented where the cross-polarized reflection, if exists, can be reduced in order to improve the overall absorption. The cross-polarized reflection and its mitigation are theoretically and quantitatively analyzed. Furthermore, in order to design a broadband circuit analog absorber (CAA) using array of conductive crossed dipoles with lumped resistor loading, a simple synthesis technique is proposed. The radar cross section (RCS) reduction capability of this absorber is analyzed. In addition, a moment method formulation is presented to theoretically obtain scattering response of infinite array in waveguide simulators. This theoretical analysis validates the utility of waveguide simulators for experimental measurements of the infinite array. All the proposed absorbers in this thesis are insensitive to the TE and TM polarizations and quite stable for oblique angles of incident EM waves. According to the Federal Communications Commission (FCC) defined radar spectrum, the proposed absorbers in this thesis can be used as radar absorbing material (RAM) for shipborne, airborne, ground air surveillance radar signal avoidance. Finally, some future scopes and challenges of this rapidly expanding field are briefly addressed.

Keywords : Absorber; Absorption; Bandwidth; Cross-polarization; Frequency selective surface (FSS); High impedance surface (HIS); Polarization; Radar cross section (RCS); Scattering; Thickness; Unit cell.