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Improving Return loss of Microstrip Patch antenna using AMC

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Abstract: ***To develop new materials with desirable electro-magnetic properties those are not currently available to microwave engineers. One unifying theme of the materials should be moderately low loss magnetic materials for microwave applications. Specific properties we have investigated are impedance matched materials, tuned enhanced permeability, reactive impedance surfaces, and negative permeability electromagnetic band-gap materials.***

Keywords: **Perfect ground Plane (PGP), Perfect Magnetic Ground Conductor (PMC), Artificial Magnetic Conductor (AMC).**

I.RELEVANCE

Microstrip or patch antennas are becoming increasingly useful because they can be printed directly onto a circuit board. They are becoming very widespread within the mobile phone market. Recent advances in wireless communications systems, such as GSM and DCS in Europe, PCS in America, wireless local eddy area networks (WLAN)[22], wireless local loops (WLL), future broadband 3G systems and etc., have instigated a flurry of interest in microstrip antennas. This is mainly due to the unique features of microstrip antennas They are low cost, have a low profile and are easily fabricated. A microstrip antenna consists of conducting patch on a ground plane separated by dielectric substrate. This concept was undeveloped until the revolution in electronic circuit miniaturization and large-scale integration in 1970[22]. After that many authors have described the radiation from the ground plane by a dielectric substrate for different configurations.

Zhang *et al.* [2] introduced a simple approach for solving the AMC structure shown in Fig. 1. Their approach is based on a simple equivalent circuit model for the periodic patch antennas. This circuit consists of capacitive resistive loads connected by transmission line sections. These capacitive resistive loads correspond to the capacitance effects between the patches and the resistance is due to the radiation effects from the edges of these patches. However, the main disadvantage of their model is that it can be used only for normal incidence.

Clavijo *et al.* [2] introduced another approach for simulating mushroom type AMC surface. Their model is based on approximating the patches as a shunt capacitive load along multilayered transmission line sections.

D. Qu, L. Shafai and A. Foroozesh [2] stated that parametric studies are conducted to maximize their impedance bandwidths and gains. It is found that very wide bandwidths, of around 25%, can be obtained by variation of the original antenna and EBG parameter. Their gains are similarly increased.

Tian Hong Loh [18] concluded in his paper that a theoretical study, design approaches and the applications of mushroom-like High Impedance Surface Electromagnetic Band Gap (HIS-EBG) meta materials in antenna engineering. A tunable HIS-EBG structure is represented by a novel analytic equivalent transmission line circuit model for surface wave propagation. The analytical and numerical simulations and a parametric study on the effects of patch width, gap width, substrate thickness and substrate permittivity.

1.1 ARTIFICIAL MAGNETIC CONDUCTOR

To date, Artificial Magnetic Conductor (AMC) surfaces are receiving more and more attention because of their interesting properties that may overcome some of the problems of traditional perfect electric conductor (PEC) surfaces. The main difference considering in the electrical properties between a PEC and an AMC surface can be determined by observing the reflection coefficient. Assuming no losses, an ideal AMC, also known as a Perfect Magnetic Conductor (PMC), is a surface that exhibits a reflection coefficient of +1(amplitude is equal to 1 and phase is 0°) when applied in the situation of an uniform plane wave normally incident on an AMC plane; as opposed to a PEC, which has a reflection coefficient of— 1 (amplitude is equal to 1 and introduces a phase shift of 180°). Strictly speaking, the AMC condition is characterized by the frequency or frequencies where the phase of the reflection coefficient is 0° (i.e., where the reflected wave is in phase with the incident wave). This planar periodic Electromagnetic Band Gap (EBG) structure is particularly attractive and has been intensively investigated due to its advantage of being compact size, simple circuit, low cost, and easy to fabricate using a standard planar process without using any extra multilayer substrates or via holes. The AMC-EBG substrate reflects all the power just like a metal sheet but its image current at the ground are in phase rather that out of phase with the antenna current.[18]

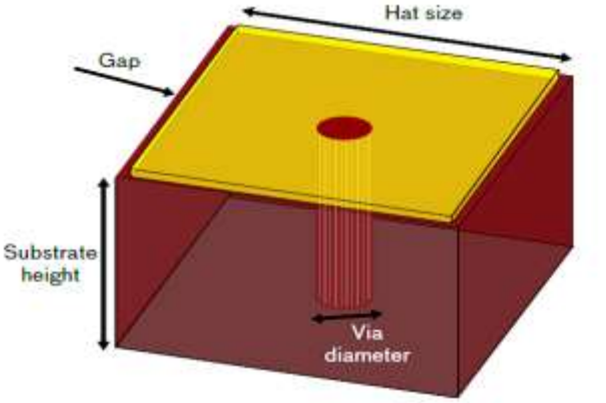

Figure 1: AMC cell structure

Sr.No.	Antenna Type	Width	Length
1	Cell	6.25mm	6.25mm
2	Internal Patch Antenna	42mm	28mm
3	Total Antenna System	85	85mm

Table 1: Fabricated Patch Antenna Dimensions

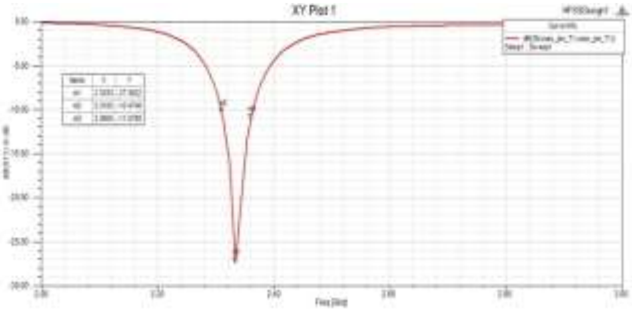

Figure 2: Practical result of PMC Return Loss (S11)

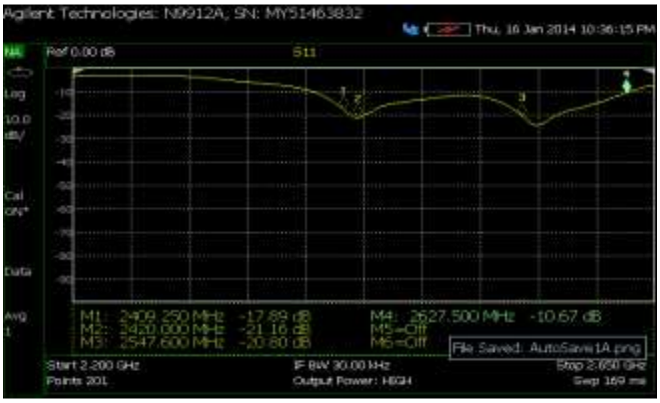

Figure 3: Practical result of PMC Return Loss (S11)

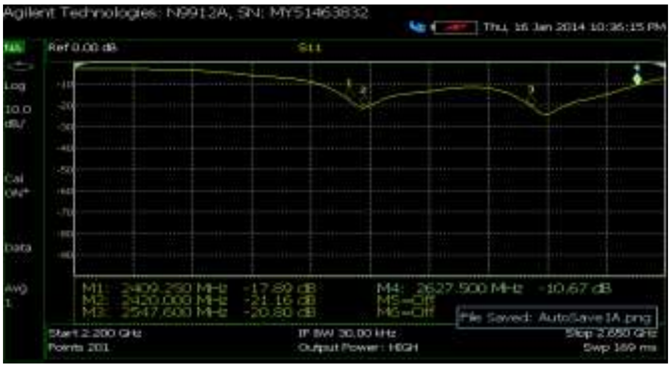

Figure 4: Practical result of AMC Return Loss (S11)

	Simulated	Measured	Remark
PMC & AMC comparison Center frequency Return loss	-27.36	-25.36	Return loss Improvement is achieved in AMC antenna
	-24.08dB	-22.86dB	Both simulated & measured results are closely match are closely matched

Table 2: Comparision of PMC and AMC

II CONCLUSION

These concepts were realized by improving upon one or more of the difficulties experienced by typical artificial magnetic conductors such as a narrow bandwidth, minimum thickness constraints, and near-field interactions causing unwanted problems in the case of AMC antennas.

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