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Comparison between PMC AND 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.

II AMC Cell & Periodic Array Design Constrictions details

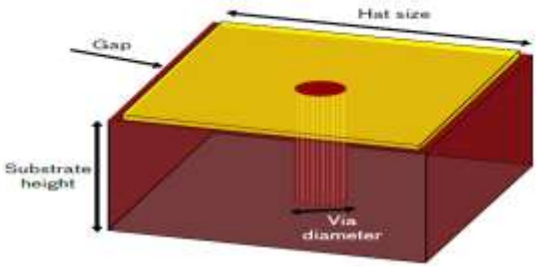

Figure1 Constructional view of AMC Cell

Material Height	1.59mm
Copper height	0.05mm
Via material	copper
Via process	PTH
Via tolerance	50micron
Plating	Green mask
Plating dielectric	1.005
Plating thickness	30micron

Table 1 Single cell Specifications

III Construction of AMC periodic structure

The Periodic array-cell of an AMC-structure consists of a square patch, a metallic ground plane, via connected between the patch and the metallic ground plane, and a square block of substrate. It operates at frequencies where the periodicity is small compare to the operating wavelength of incident waves. In Figure 5.4, the parameters of the AMC structure: w, g, D, h, εr, μr, r, wp, Lp are respectively, the width of the patch, the gap width between adjacent patches, the lattice constant, the substrate thickness, the permittivity and permeability of the material surrounding the AMCEBG, the substrate permittivity, the substrate permeability and the radius of the vertical conducting Via.

These parameters can be used to tailor the characteristics of the surface impedance. For example, by applying a texture to a metal surface, one can alter the electromagnetic boundary condition of the metal surface and, hence, its surface impedance, thereby changing its surface wave properties [18].

A. Theoretical Design

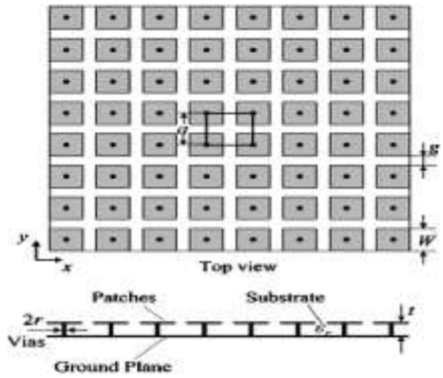

Figure 2 Top view of AMC

Figure 3 Artificial Magnetic Ground Planes analysis [E]

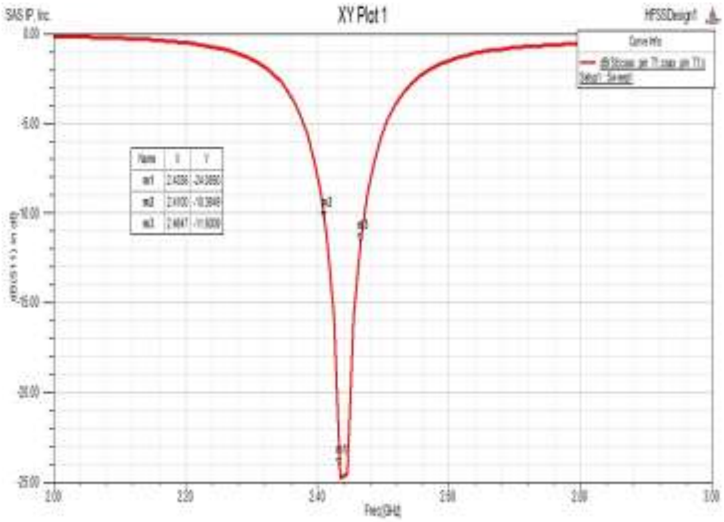

Figure 4 Simulated Return Loss (S11) of PMC

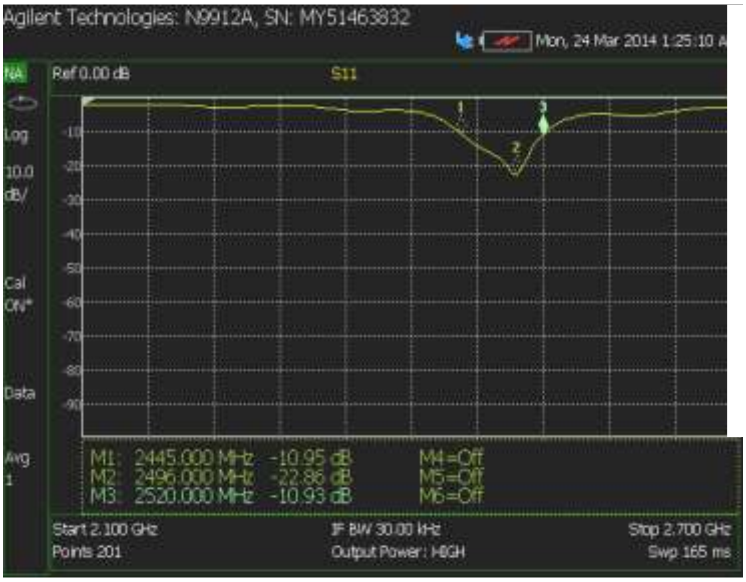

Figure 5 Measured Return Loss (S11) of PMC

PMC	Central frequency	Start	Stop	BW
Simulated result	2.43 GHz	2.41GHz	2.46GHz	50 MHz
Measured result	2.49 GHz	2.45GHz	2.55GHz	105MHZ

Table 2 Simulated and Measured Results of PMC

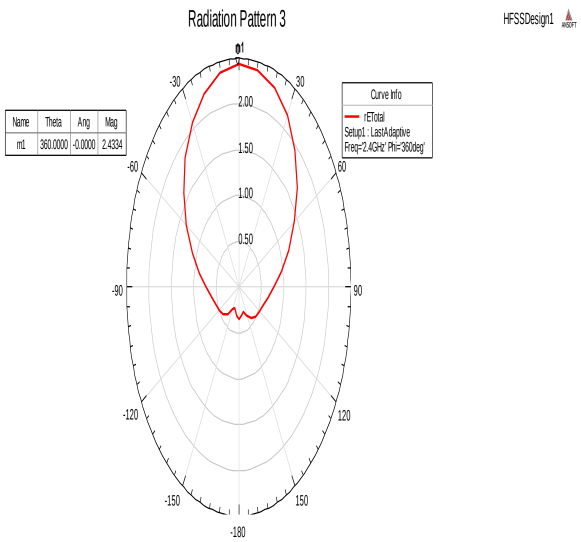

Figure 6 Shows directivity of PMC antenna.

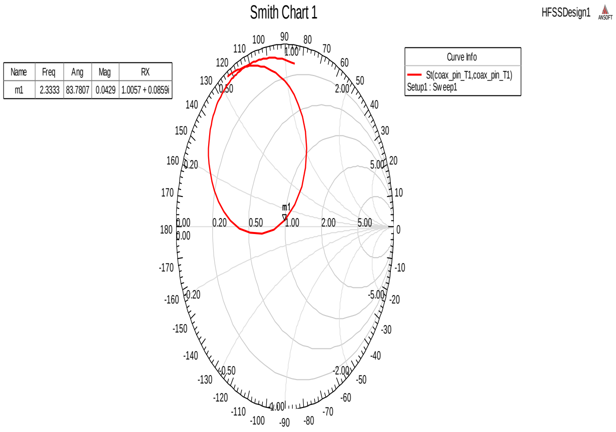

Figure 7 Simulated result of impedance using smith

Figure 8 Measured result of Smith chart on VNA

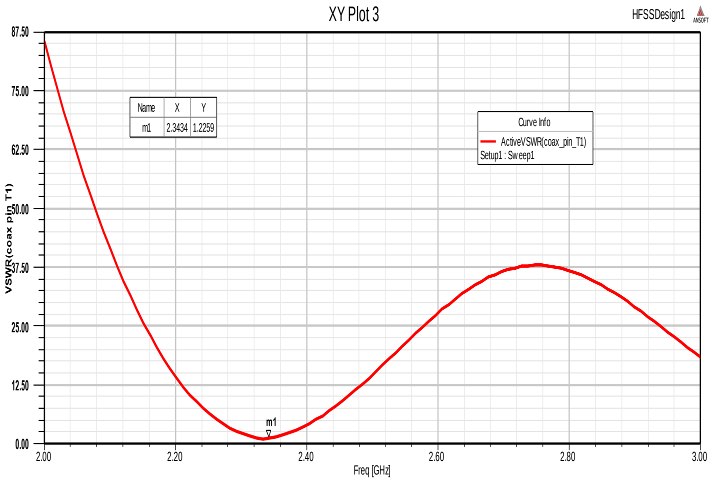

Figure 9 Measured VSWR result of PMC

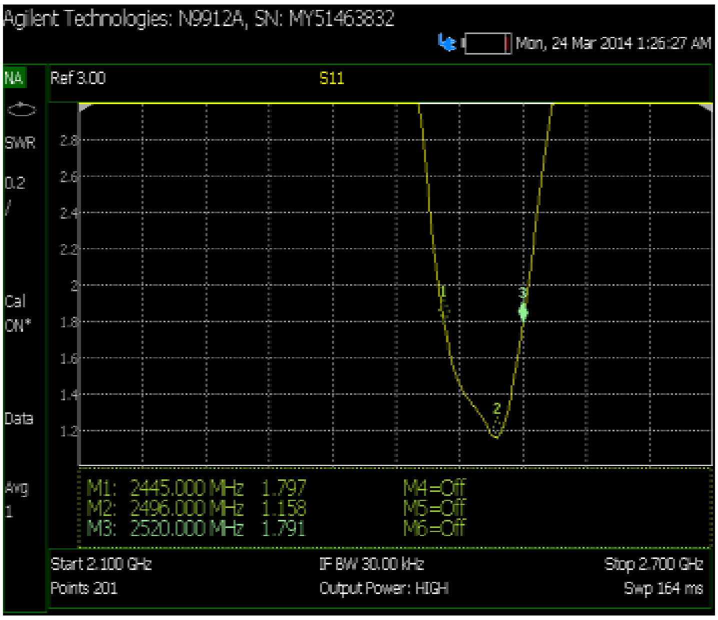

Figure 10 Measured VSWR result of PMC

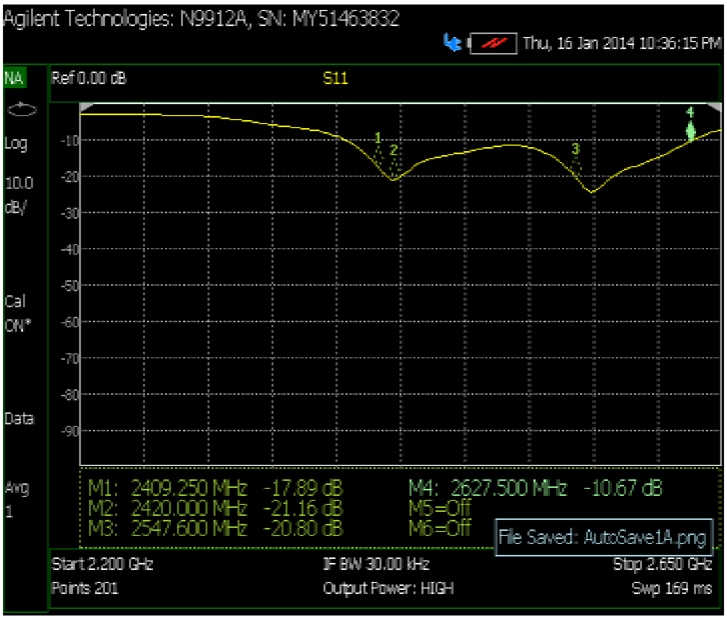

Figure 12 Practical result of Return Loss (S11)

Results	VSWR	Smith Chart
Simulated	1.22	50.0+0.04j
Practical	2.445	39.34-24.38j

Table 3 Comparison of simulated and practical results

	Simulated	Measured	REMARK
PMC & AMC comparison Center frequency VSWR	1.06	1.15	VSWR Improvement is achieved in AMC antenna
	1.1	1.19	Both simulated & measured results are closely matched

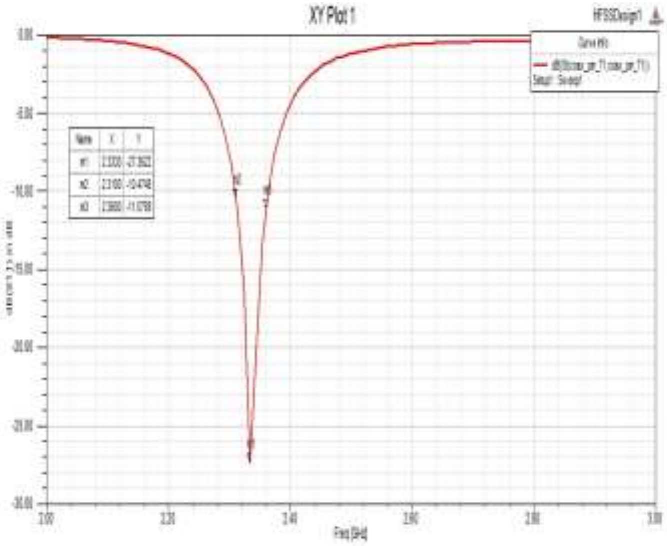

Figure 11 Practical result of Return Loss (S11)

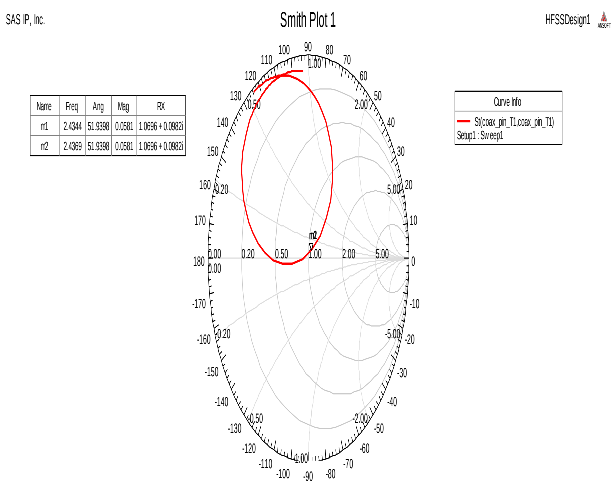

Figure13 Simulated smith chart of AMC

Figure 14 Pratical results of smith chart of AMC

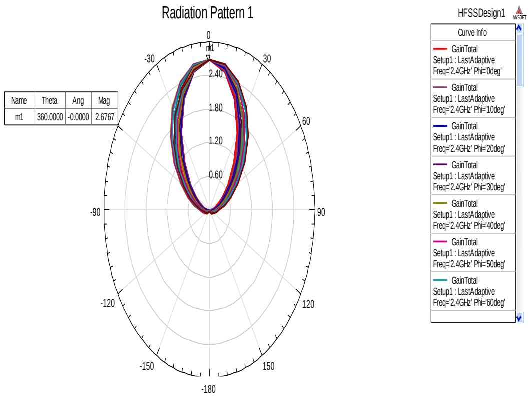

Figure 15 Radiation Patter smith chart of AMC

B Comparison between Two antennas

Due to amc stracture clean response is achived .The amc only support domieniant mode & reduce the higher order mode .AMC pattern are placed around the radiatting and non raddationg edge of microstrip antenna. The perodicity of stracture are equally & uniformally spaced across the substrate. For better condictivity, the amc pins are plated using ENIG gold(nikel and tin are the option for plating).The return loss are improved due to cummlative effect of perfect magnatic conductor. The amc are having inductance in the range of nH(it is according to 2.4GhZ)

Table 4 Comparison of Simulated and Measured Results

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