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HIS Band Gap Effect on Monopole Antenna Radiation

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***ABSTRACT*— The HIS structures have a property of reflecting some band of frequencies with zero phase shift. During this period the antenna radiation characteristics are enhanced. Remaining period the HIS structure behaves like ordinary plane reflector. Present paper monopole antenna operating within the band gap duration and out of band gap range is designed and tested over HIS structure. Simulated results have good agreement.**

Keywords: Reflection Phase, Surface wave band gap, Monopole antenna

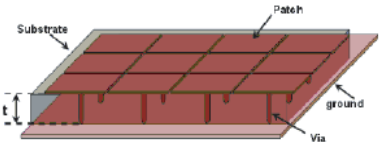
I. INTRODUCTION

Artificial Magnetic Conductors are designed by the periodic arrangement of patches over dielectrics substrate and are connected to under lying conductor with vias. This structure reflects band of EM waves with zero phase shift, and does not allow the propagation of surface waves during this band. This property is useful in enhancing the radiation characteristics of over lying radiating element.

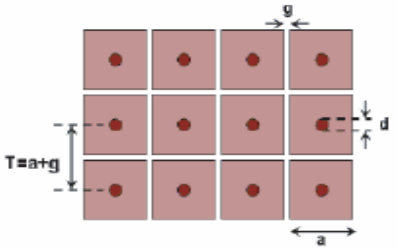
II. METHODOLOGY

2.1 EBG Design

Present paper HIS unit cell is designed with following specifications t=2.4mm, d=0.6mm, a=7.2mm, g=1.2mm, and ε_r=2.55. The structure is analyzed using Finite Element Method.



a) Perspective view

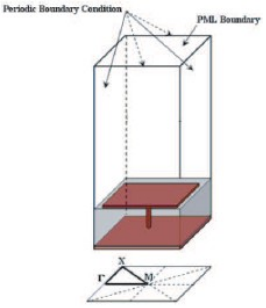


b) Top View

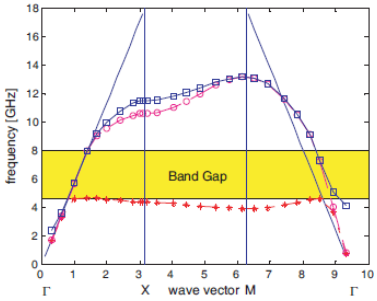
Figure 1: Geometry of HIS structure

2.2 Dispersion Diagram

The dispersion diagram is plotted for a unit cell a band gap between first mode (intersection point of TM and light line) and second mode (intersection point between TE and light line) is 4.6GHz 7.9GHz can be seen in figure 2.



a) Unit Cell



b) Dispersion Diagram

c) Figure 2:

2.3 Reflection Phase:

The reflection phase of the structure changes continuously from $+180^0$ to -180^0 verses frequency.

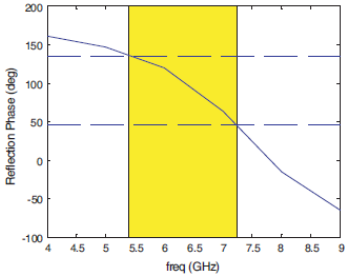


Figure 3: Reflection Phase of HIS

But zero phase reflection is obtained between the ranges of $+90^0$ to -90^0 which are equal to band gap of structure.

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III. MONOPOLE ANTENNA

Monopole antennas are popular for wide band wireless communication applications. They are easy to fabricate and low cast. Initially monopole antenna is operating at 6GHz tested over normal ground plane and latter on HIS surface.

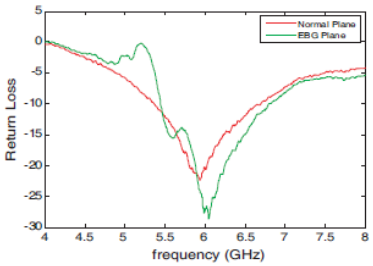

Figure 4: Return Loss of Monopole on normal plane and HIS

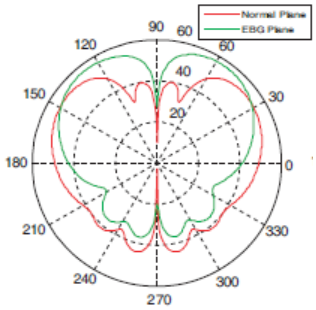

Figure 5: Radiation Pattern on normal plane and HIS

As we see the radiation pattern figure 5, there are ripples in forward direction and significant amount of power is wasted in back lobes under normal plane. Smoother radiation pattern is obtained over HIS

Now monopole antenna is designed to operate at 8GHz which is beyond the band gap range shown above, is tested over normal plane and HIS surfaces.

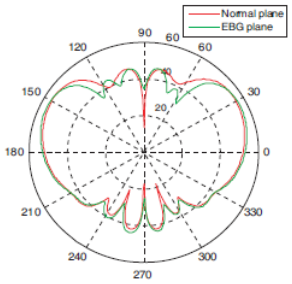

Figure 6: Radiation Pattern at 8GHz on normal plan & HIS

Beyond the band gap the HIS structure functions similar to normal plane. At this stage HIS supports surface wave.

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