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Design & Simulation of Dielectric Resonator Antenna for Millimeter Applications

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Abstract:
This paper presents the design and simulation of broadband Dielectric Resonator antenna using HighFrequency Structure Simulator (HFSS). This paper investigate stacked cylindrical DRA,s placed on concentricannular rings .These hybrid nature of structure is operating under controlled electric fields and magneticfields. Higher gain has been reported in proposed work when electric bias is given , under magnetic biasbandwidth of the antenna is enhanced by making little bit compromise on the Gain. Frequency shift has also been notice during magnetic and electric bias condition .This can be wisely used for getting reconfigurability.

Key Words: ***Cylindrical DRA, Annular ring, circular patch, Dc bias.***

I. INTRODUCTION

Microstrip antenna is an ideal choice for wireless communication due to low profile, light weight , conformal shaping, low cost ,simplicity of manufacturing and easy integration to circuit [1].However, conventional microstrip patch antenna suffers from very narrow bandwidth, typically about 5% bandwidth with respect to central frequency.
Single feed dual frequency patch antenna fed by coaxial probe to circular patch as working principle on concentric [2]-[3]. Circular patch embedded in concentric stacked dual annular ring with stacked DRAs [4]-[5], DRA have received lot of attention. The DRA has several advantages such as radiation efficiency, low conducting loss, ease of fabrication [1]. The concentric stacked annular ring working on shorted circular patch and inner annular ring with DRAs. Gain achieved 1.5 dB before biasing, after d.c. biasing gain increased to 7.9 - 11 dB .

II. ANTENNA CONFIGURATION

Here we have design 3 different antennas Circular Patch, Copper annular ring , DRA of high gain and high bandwidth with ε_r =5.7,10. The single layer antenna with two copper annular ring concentrically located around a circular patch with DRA's .It is printed on FR4 substrate of thickness 1.52 mm ,relative permittivity is 4.2, loss tangent 0.018 and 50Ω impedance .Dimension of our antenna.

Sr. No.	Parameter	Antenna
1.	R_1	22.7
2.	R_2	16.4
3.	R_3	6
4.	W_1	0.8
5.	W_2	5
6.	Feed Point	-4.5,-4.5

Make a design to given parameters and embedding DRA in circular patch of height 12.5 mm and inner annular of height 25 mm.

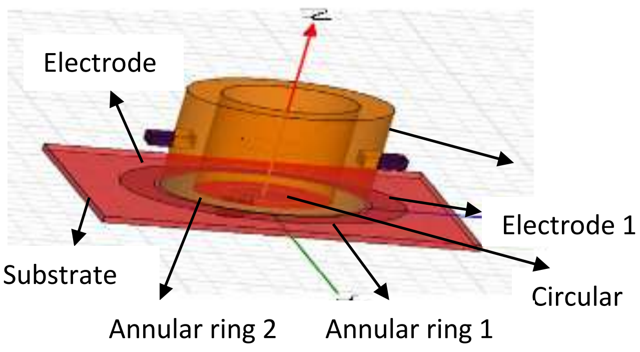

Fig.1 Front View of Antenna

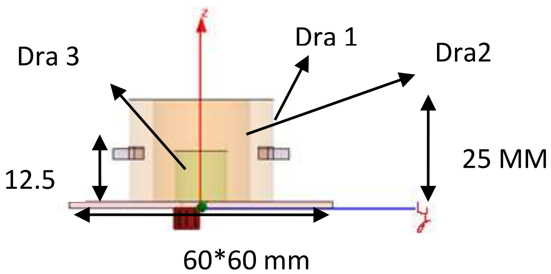

Fig 2 Side view of MHD antenna

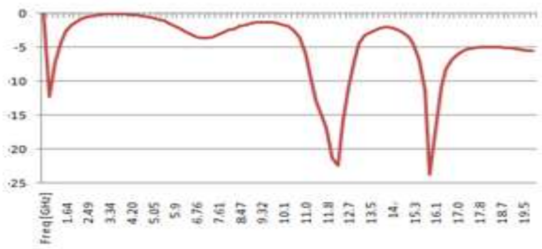

Fig. 3 s11 Without using Stacked DRA

Proposed antenna working as multiband type antenna their s11 present in the fig. 3.

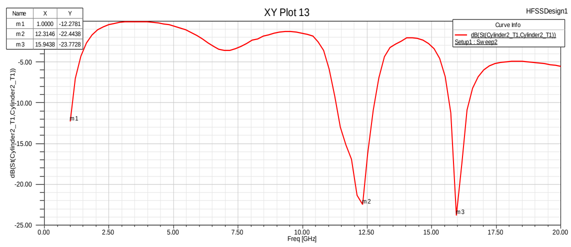

Fig. 4 Return loss without using stacked DRA

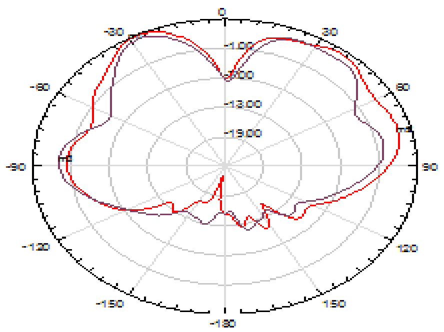

Fig 5. Radiation pattern without using biasing.

In this structure when DRA adding with ε_r=5.7, 10 achieved the bandwidth of this antenna 2.5 to 12.9 GHz and return loss is -4.5 dB fig. 4.

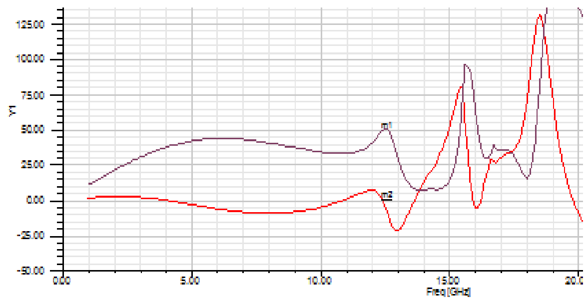

Fig. 6 Impedance matching

Impedance matching in fig.5 real part m1 is 49.93 and imaginary part m2 is 0.785 so proper impedance matching on 12.4 GHz of resonant frequency.

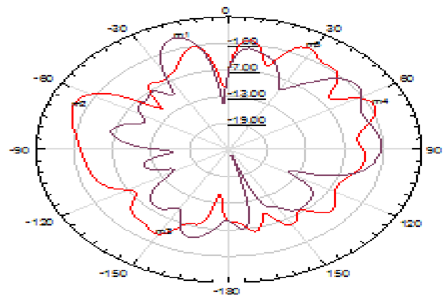

Fig. 6 Radiation pattern

When complete the structure concentric annular rings embedded DRA then achieve the gain 1.5 dB. Show in figure 6.

D.C. bias using in this structure then s11

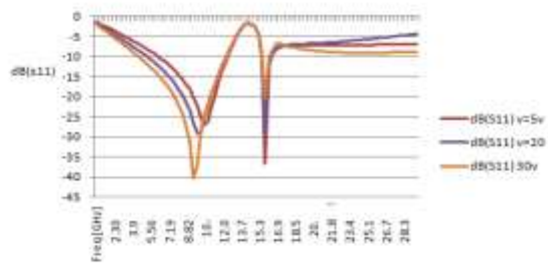

Fig. 7 Return loss using D.C biasing

A gain of 4.99db is achieved when the proposed antenna is biased with 5v. The figure 8 shows the radiation pattern of the antenna when feed with 5v supply.

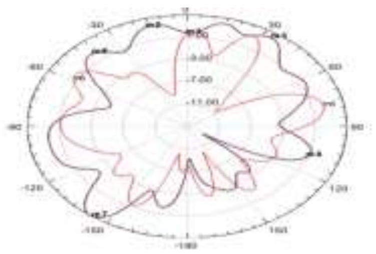

Fig. 8 Radiation pattern using 5v D.C biasing

In figure 9 gain is achieved **7.79 dB.** After ground doing negative and both of electrode assign positive voltage 20v then gain is 9.67 dB in fig. 9.

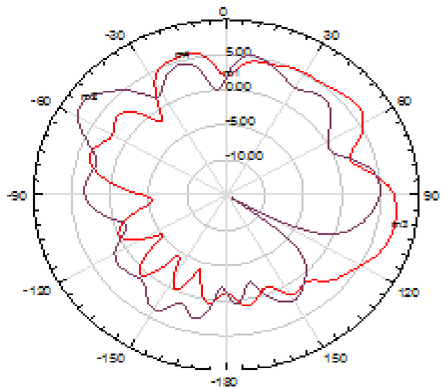

Fig. 9 Radiation pattern using 20v D.C biasing

When applying 30v dc bias then gain increases to 11.09 dB as shown in figure 10.

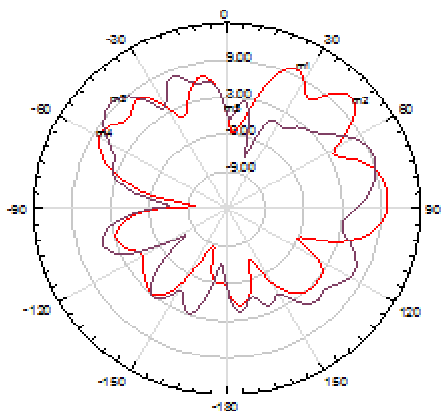

Fig. 10 Radiation pattern using 30v D.C biasing

When applying 30v then gain will be increased as 11 dB but s11 is same. After in this experiment I apply 5v D.C. Bias then s11 is given below in fig 7.

Adding magnetic bias of 2500 T magnetic saturation in this structure then s11 show in figure 11.

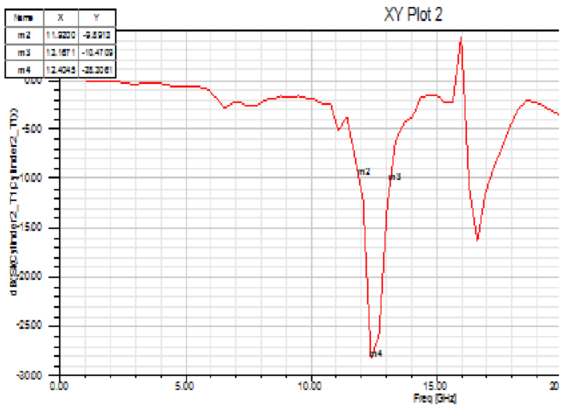

Fig. 11 Return Loss

IV. CONCLUTION

In this paper impedance, bandwidth higher 10GHZ and with d.c. bias this bandwidth is 8 GHz but gain improve of 75% is achieved when given magnetic bias with different magnetic saturation, it decreases return loss and give effective radiation pattern. It has wide application in wireless communication, military, naval, air force and nano photonic applications.

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