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DESIGN AND PERFORMANCE ANALYSIS OF "O" SHAPE MICROSTRIP PATCH ANTENNA FOR SUPERIOR RADIATION

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ABSTRACT

In this proposed design of a Microstrip patch antenna, have designed with the lower dimension of "O" shape Patch for superior radiation. At 2.45 GHz the patch gets radiated with perfect impedance matching. It has a dielectric constant as 2.2(RT DUROID 5880). Porosity and Permittivity are related properties of ceramic material. The doubly doped Nano ferrite Meta Ceramic material has placed in an antenna substrate part. The Synthesized substrate material (Mg Ce_x Yb_y $Fe_{2-x-y}O_4$ (X= 0.03 Y=0.05) has both low perm and low porosity. The proposed design have analyzed by using various simulation software (HFSS v11 & ADS 2009) and real time work. From these output report, the minimum dielectric material provides the better gain and radiation with miniaturized design of Microstrip line feed MSP.

KEYWORDS: MSP, HFSS v11, ADS 2009, Gain & Radiation pattern.

I. INTRODUCTION:

The Microstrip patch antenna is a basic key builder to wireless communication. They are light weight, affordable, easy to manufacture and can easily be used in hand-held devices like mobile phone..,. In the Design of patch antenna, they are lot of parameters are must be considered. From this, the substrate material and lower dimension are very important for miniaturized design for various hand held usages. Since the "O" shape Microstrip patch antenna are selected for reducing the dimension for better radiation and Gain.

Particularly, there are five substrates that can be used for the design of MPAs and their dielectric constants are usually in the range of $2.2 \leq \varepsilon r \leq 12$. There are Honey comb($\varepsilon r = 1.07$), Duroid($\varepsilon r = 2.2$), Quartz($\varepsilon r = 3.8$), FR4($\varepsilon r = 4.4$) & Alumina($\varepsilon r = 10$). The RT-Duroid ($\varepsilon r = 2.2$) with thickness 0.5inches have selected as a substrate for design of patch antenna. The meta materials are synthesized by using Sol-Route method. In this method provides the quality material without any lose of Characterization at very low temperature. And also these materials preparation cost is very low with short period. After the Synthesized process, the materials have taken to Characterization by using X-RD, SEM. The radiation increases with frequency increase and using thicker substrates with lower permittivity. Since our selected material has lower permittivity ($\varepsilon r = 2.2$) and 2.45GHz as a resonance frequency and also have a lower porosity (minimum vacuum). The dielectric constant is the ratio between the stored amount of electrical energy in a material and to that stored by a vacuum. The better lower £r of material works as an insulator, and the better an insulator, As better it resists electrons from being absorbed in the dielectric material, it will be creating less loss. So, automatically, the dimension of Patch gets reduced. It will very helpful to decrease the Return loss and ringing fields".

II. DESIGING PROCESS:

The Geometry design of "O" shape Microstrip patch antenna is designed in real time as well as Simulation with the different simulation software. The corresponding designing parameters are length and width both are calculated by Microstrip patch calculator and EM Talk calculator.

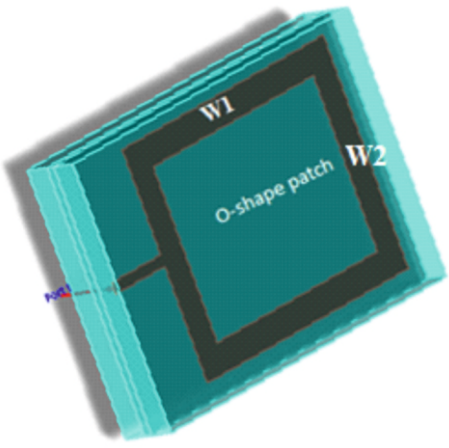

Figure 1- "O" Shape MSP Antenna

The dimensions are calculated with help of resonating frequency and permittivity. The Following table shows the parameter for designing process.

Resonance Frequency	2.45GHz
Dielectric constant	2.2
Height of the Substrate	1.5mm
Patch Width	47.5mm
Patch length	39mm
W1 & W2(O shape)	6mm & 8mm
Ground plane dimensions Lg and Wg	48mm and 56.5mm

III. CHARACTERIZATION STUDIES:

X-RD:

The X-ray diffraction is most extensively used technique for the characterization of the materials .This technique used for gathering information regarding crystalline nature of a material and grain size.

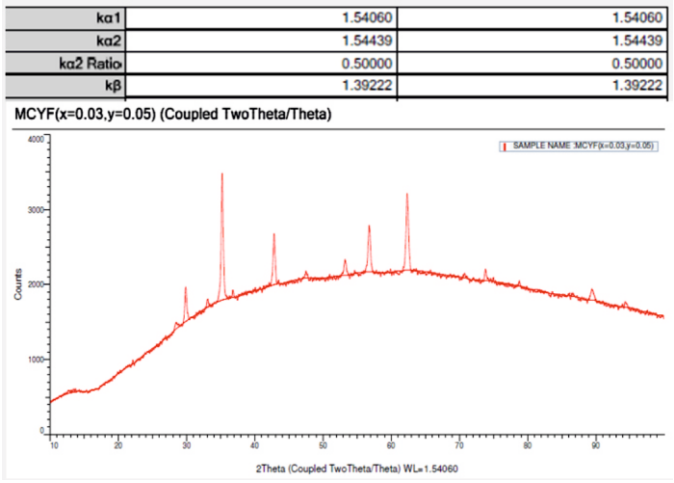

Figure 2- X-RD pattern for MCYF(x=0.03,y=0.06)

The crystal size was evaluated by measuring the FWHM of the most intense peak (311) from XRD Figure 2.

The size of the crystal was determined by using the Debye Scherer's formula, given as Scherer's formula

$$D = \frac{0.94\,\lambda}{\beta \cos\Theta}$$

Here λ was 1.5406Å.

From the report, the particle size is very small Hence it proved by the higher peaks in the pattern. Thus it confirms the application of this as prepared material will be useful for micro strip patch antenna construction.

SEM:

The scanning electron microscopy is used to analyze the surface of the solid objects, producing higher resolution images than optical microscopy. Scanning electron microscope (SEM; S3000-H, Hitachi, Japan) was used to obtain the SEM microscopic of as-prepared nano ferrite materials to determine the particle size of $MgFe_2O_4$ specimen; the SEM monograph shows the presence of a monophasic homogenous microstructure.

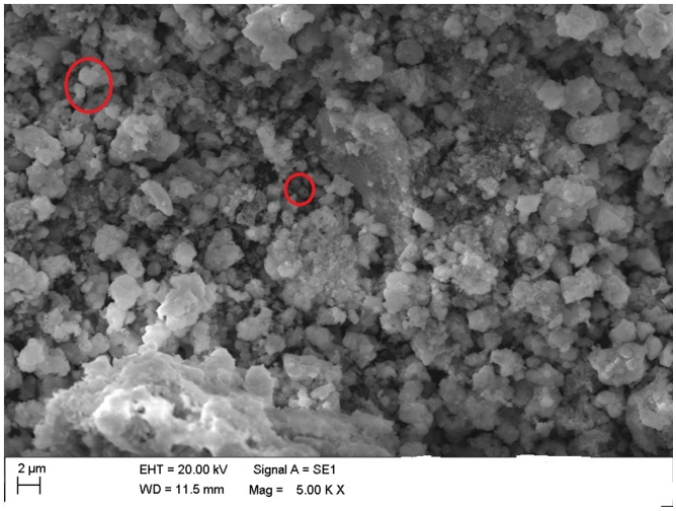

Figure 3- MCYF(x=0.03,y=0.06)

IV. HFSS VII SIMULATOR:

HFSS is a high-performance full-wave electromagnetic(EM) field simulator for arbitrary 3D volumetric passive device modeling that takes advantage of the familiar Microsoft Windows graphical user interface. It integrates simulation, visualization, solid modeling, and automation in an easy-to-learn environment where solutions to your 3D EM problems are quickly and accurately obtained. Ansoft HFSS can be used to calculate parameters such as Gain, Resonant Frequency, and Radiation pattern. In this proposed work were implement by using HFSS v11.

SMULATION OUTPUT

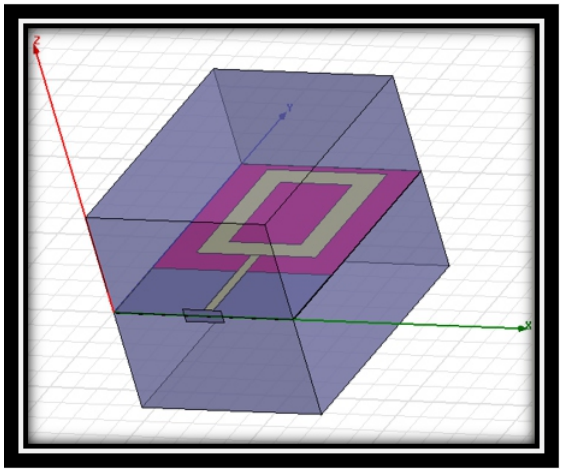

Figure 4- "O" shape MSP using HFSS V11

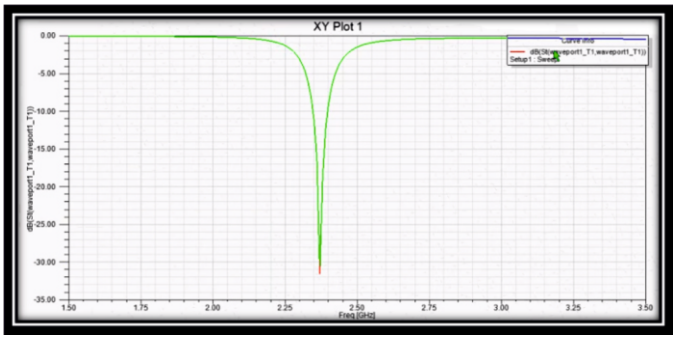

Figure 5- Return Loss

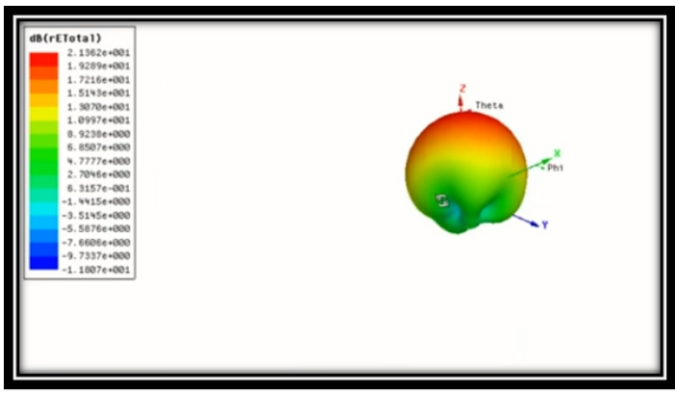

Figure 6- Gain

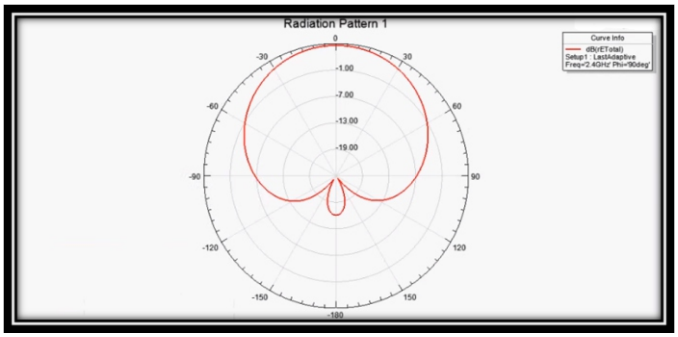

Figure 7- Radiation Pattern

V. ADS 2009 SIMULATOR:

In ADS 2009, "O" shape MSP design has been design with the following dimensions. The permittivity of the substrate material (RT-Duroid) has 2. 2. The dielectric height of the material is 1.5 mm, which will be helpful to reduce the surface wave loss. The mesh frequency of the design is 3 GHZ. The designed antenna has been simulated for 25 samples. From this simulation the Return loss and Smith chart for 50 ohm impedance. The animated output and the antenna parameters are fetching from this simulator. This software is easy to get the output efficiently with short duration.

SMULATION OUTPUT

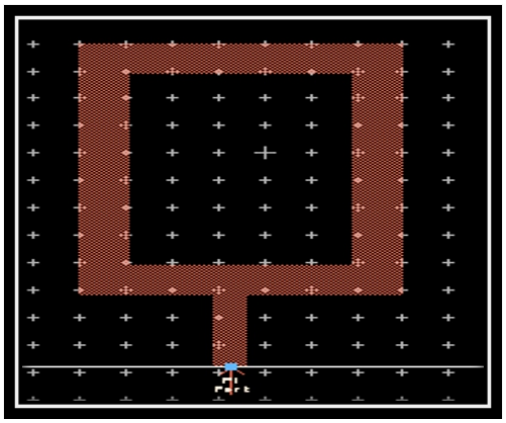

Figure 8- (a) "O" shape MSP using ADS 2009

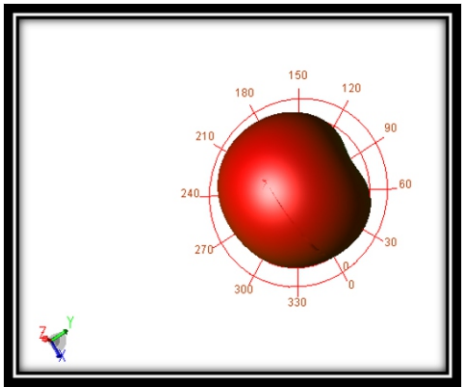

Figure 8- (b) Radiation Pattern

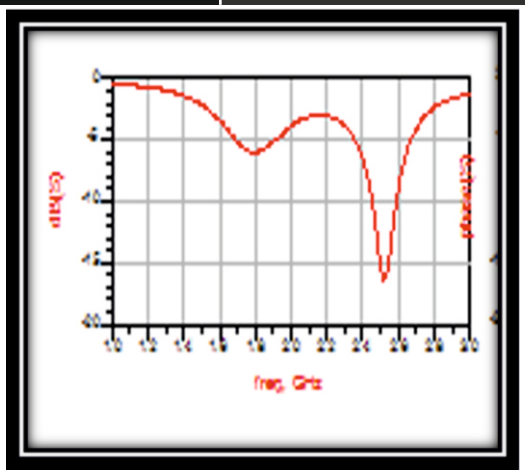

Figure 9- (a) Return Loss

Power radiated (Watts)		0.774324
Effective angle (Steradians)		3.06708
Directivity(dB)		6.12484
Gain (dB)		5.01407
Maximim intensity (Watts/Steradian)		0.252463
Angle of U Max (theta, phi)	0	0
E(theta) max (mag,phase)	0.814394	-34.1158
E(phi) max (mag,phase)	13.768	144.788
E(x) max (mag,phase)	0.0938666	-25.6728
E(y) max (mag,phase)	13.7917	144.792
E(z) max (mag,phase)	0	180

Figure 9- (b) Gain

VI. REAL TIME WORK:

In the Real time work, the "O" shape Microstrip patch antenna has designed. Initially, the RT-Duroid plates are cleaned. With help of the Microstrip patch calculator and Em-talk the patch width, length, "O" dimensions and ground plate dimensions were calculated. The calculations have drawn perfectly with these dimensions.

Material preparation:

The Nano ceramic Meta materials (MCYF) are taken with correct ratio. The Materials measurement takes by using Denver instrument. To mix the distilled water with that material upto reach 250 Ml. Then, these mixtures have taken to Stirrering process. Our substrate material adjusts the PH value as 7 with help adding ammonia. At 100°C the material gets heated. The liquid gets changed to jell format. Then the heating process will be continued upto ash formation. Then final product has grained. Finally, the material sintered at 800°C. The substrate material is ready to apply in the substrate part.

The RT-Duoid plates are dipped in the ferric solution. That helps to remove the copper coating in the undefined part in the plates. Then edge feed method are implemented for input session. Now, the "O" shape antenna has designed.
After that the outputs are taken with help of aronia spectrum analyzer.

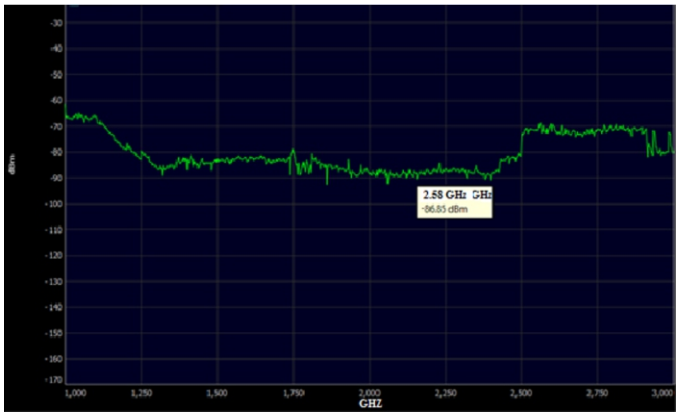

Figure 10 – Return loss

Output Comparison:

Parameters	HFSS V11 simulation Result	ADS 2009 simulation Result	Real time design with manual calculation result
Resonating frequency	2.45	2.5	2.58
Gain	2.1962	5.0140	6.284
Return loss	-32db	-17db	-86.85dBm

VII. CONCLUSION:

Thus the design and simulation of "O" shape Microstrip patch antenna was successfully designed and analyzed using Ansoft HFSSV11 & ADS 2009 with Real time Work. The Gain, resonating frequency & return loss are analyzed. With help of manual calculation the real time Gain will be 6.284db with RL=-86.85dBm. Hence these high gain and low return loss proved as the proposed design "O" shape patch provides high efficiency and superior radiation with miniaturization design.

VIII. REFERENCE:

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