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ANALYSIS OF GAIN SET UP USING 2 × 1 SERIES ARRAY MICROSTRIP PATCH ANTENNA WITH LOW PERMITTIVITY

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ABSTRACT

In this paper, the low profile antenna has designed for microwave application. The material of substrate for antenna design is synthesized by using SOL-GEL route method. Through the material characterization XRD and SEM, the substrate materials have tightly backed. With lower permittivity substrate "O" shape microstrip patch antenna and 2 × 1 series array are designed. The input power is passing through lumped ports with 50Ω impedance. The microstrip line feeding methods have chosen for both design analysis. The designs are simulating by using HFSS v11 software for better result reports. From these output analysis, the array antenna design provides the high gain in db. Hence this report proves as the gain set up through series array structure.

INTRODUCTION:

In recent years, the wireless communication expects the highly efficient with lower return loss antennas for communication. The microstrip patch antennas are satisfies the needs in research of high gain antennas. The return loss parameter always depends upon the impedance matching. In this proposed design of both single antenna and series patch antenna array are designed with the 50ohm. There are two types of ports are available to design the antenna such as lumped port and wave port. From these two the lumped port is useful to prove the high output efficiency than wave port design. Since, these proposed designs have designed with lumped port. Normally if the dimensions are increased manner, the outputs are gradually increased. But, technology improvement, expects the highly output efficiency, low loss with miniaturization. There are four types of shapes are used for substrate design such as rectangular, square, triangular, circular shape.

Here, "O" shape design has chosen as substrate shape. Because it has lower dimension. Simply deign the 2 × 1 with microstrip line feed method. The array which will be formed by the array elements are arranged in a desired manner. Series array and corporate array are types of array design. In series feed, the element are arranged in a line form. The elements are arranged in parallel manner that is called as corporate feed.

The Nano ferrites are doubly doped with lanthanides are formed to create the substrate material. Those have lower dielectric constant. This will be helpful to set up the gain of antenna. Generally, the substrate materials have lower porosity. Through the X-RD and SEM characterization, test the material structure. The atoms are arranged without lower gapping space. Then the porosity testing, the filled space is higher than void space in the material.

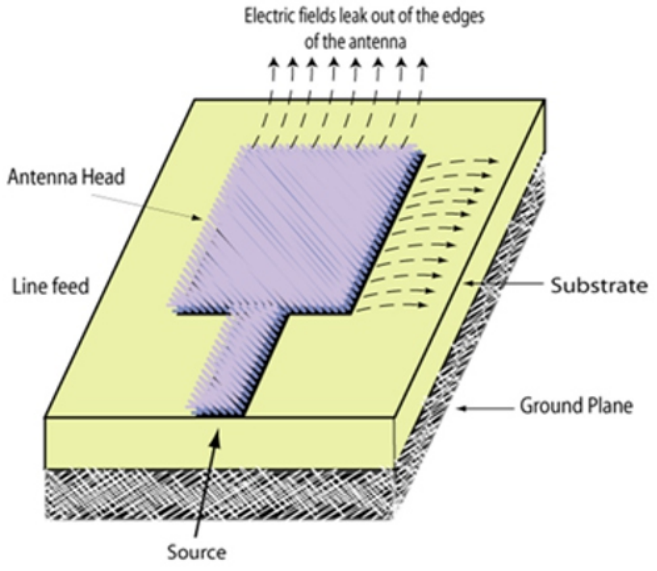

Figure 1.1- Microstrip patch antenna.

MATERIAL CHARACTERIZATION STUDIES:

Sol-Gel method:

Using SOL-GEL method, the material ($Mg\,Er_x\,Nd_y\,Fe_2O_4$ x=0.15,y=0.2) are doubly doped. Initially, these materials are calculated by using Denver instruments very aquirately. With help of ammonia, the PH adjustment by using PH meter. Then heating process will be done by heating mantel. At the end of the process, get the ash form of material. Then, graining process which will be useful to form the well Nano sized powder. The Die-set, instrument forms the Pellets as solid shape material. Then calculate the dimension of pellet using Travelling Microscope.

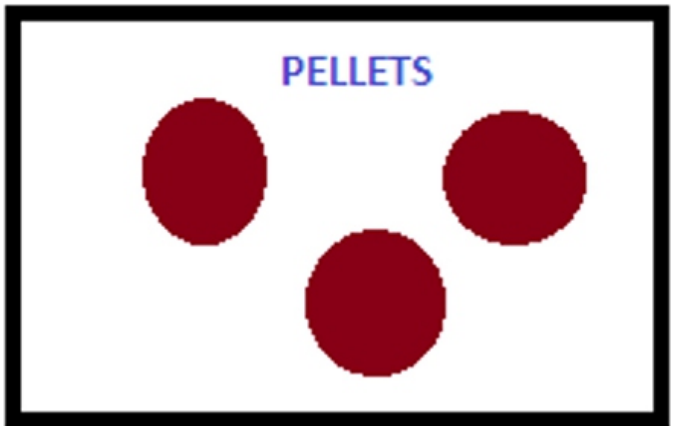

Figure 1.2- Pellets

POROSITY:

The substrate material is tested for porosity calculation. This type of calculation has done by Water saturation method. There are lot of methods are available to test the materials. Oil, waters are generally selected for ceramic material characterization testing. In this proposed design the water will be helpful to test the atom structure arrangements. The porosity," How much amount of water or gas by material" . If the material absorbs the lot of water quantity, the material's have highly void space. Otherwise, the material have lower absorption, it have highly filled space. That is tightly backed. Hence, the material has lower permittivity and porosity. Sure and sure it will be useful to set up the gain of the antenna. From these report, the substrate material have 77% filled space and 23% void space.

X-RD, SEM:

From the XRD report, it have lot of highly peaks are displayed in the report. The peaks are indicating the Nano sized particles in material. SEM testing, helpful to display the structure of atoms arrangement in the material.

HFSS V11 SIMULATOR:

In antenna design, there are lot of simulators are available. But in HFSS shows the lot of output parameters Such as return loss, Gain (total, phi, Theta), Directivity (Total, phi, theta), incident power, radiated power, accepted power, radiation pattern in 2D as well as 3D, polarization in circular and spherical structure, …etc.

STEPS TO DESIGN THE ANTENNA:

1. Ground design
2. Dielectric material selection
3. Substrate design
4. Port assignment in zx axis
5. Radiation box designing in xy axis
6. Boundary
7. Analysis
8. Simulation

In analysis step, just assign the frequency setting and delta as 0.02.Then sweep frequency settings assign the minimum and maximum frequency setting for graphical display. Before Simulation step, must save the project hen simulation will be start. Then needed results are taken from these simulators.

SINGLE ANENNA DESIGN:

In this Simulation, the single antennas have designed with 50:40 mm range. The dielectric constant is 2.32. Er selection is done by 2.2≤Er≥ 12. Lower dielectric constant is increase the antenna efficiency. Then tangent loss is 0.02. The substrate height is 1.57mm to reduce the surface wave loss. From these output report, some parameters are displayed below.

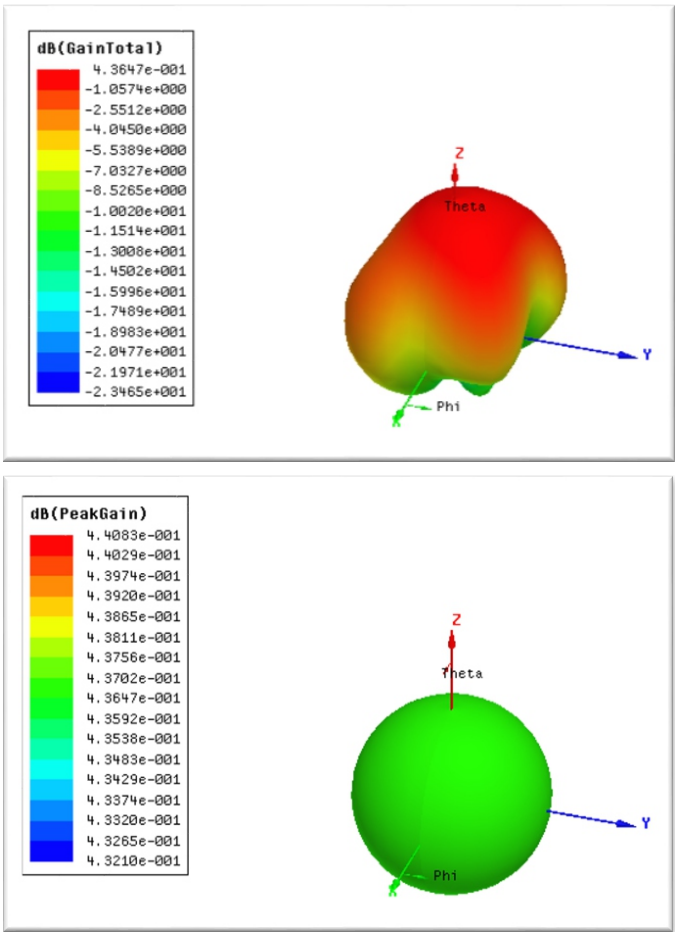

Figure 1.3-(a) gain total, (b) peak gain

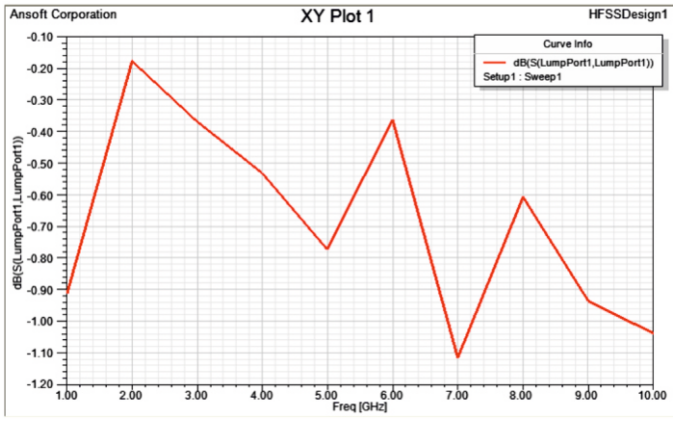

Figure 1.4- return loss

ARRAY DESIGN:

Initially, the single antenna is designed with lumped port and microstrip feed line method. After simulation, study the output range with correct units. The antenna elements are arranged in series manner. Only two elements are used to design. In array design, the each and every element have uniformly dimension.

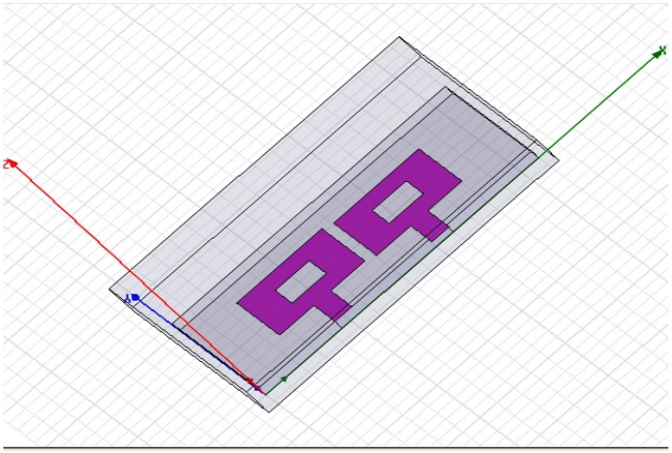

Figure 1.5- "O" shape 2 × 1array MSP

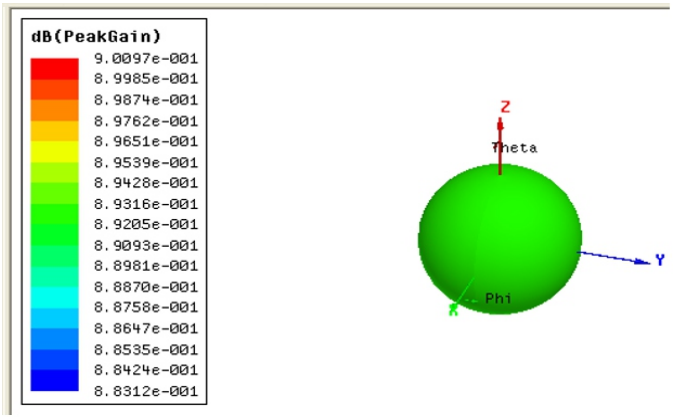

Figure 1.6- peak gain

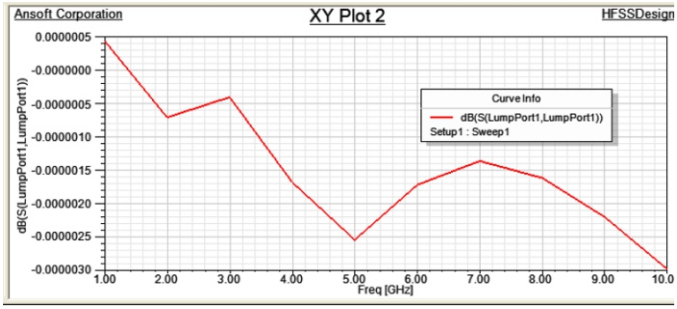

Figure 1.7- return loss

OUTPUT COMPARISON:

From these both designs output analysis the antenna parameters are tabularized.

S.No	Antenna parameters	Single antenna design	2×1 series array
1	Gain PHi	3.6356	3.6765
	Gain Theta	4.2241	5.9474
	Directivity PHi	1.9315	2.2377
	Directivity Theta	2.1569	2.2966
	Beam area	8.7684	8.8214
	Peak Gain	4.4083	9.0097
	Peak directivity	2.3337	2.4007
	Polarization in Circular	2.5750	-5.4254
	Polarization in Spherical (PHi)	3.5479	5.1154
	Polarization in Spherical (Theta)	3.0709	5.5611
	Realized Gain Total	-1.0564	-5.4882
	Realized Gain PHi	-1.0538	-5.5407
	Realized Gain Theta	-1.0479	-5.5100
	Radiation PHi	-4.7675	7.2437
	Radiation Theta	-4.7396	7.3025
	Radiation Total	-4.7170	7.31166

CONCLUSION:

In these proposed design the doubly doped Nano Meta materials are successfully synthesized by sol-gel route method. The porosity calculation have displayed as 77% filled space. Hence it proves the low perm and low porosity. Using HFSS V11 simulation, the single and array antenna are designed with "0" shape and microstrip line feed method. Finally the output reports are analyzed. The array design set up the gain as 9.0097 compared than single antenna.

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