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ANALYSIS OF LINEARLY POLARIZED CIRCULAR PATCH ANTENNA DESIGN FOR BIOMEDICAL APPLICATIONS

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ABSTRACT

This proposed Circular patch antenna, which is resonating at 2. 45 GHz for biomedical applications. While designing, several vital parameters are considered for better efficiency. The antenna is made up of RT- Droid substrate with 2.2 permittivity, because of easy of fabrication and biocompatibility compared than other semiconductors. The Doubled meta material $MgSm_xHo_yFe_{2-x-y}O_4$ (x=0.04 y=0.05) is synthesized for antenna substrate material. The material's characterization is analyzed from X-rd and SEM. The Substrate material's Structure and atoms arrangement are analyzed with help of Crystal maker software. The porosity and density are calculated by using Water Saturation method. The design is fabricated by using Antenna magus 5.1.0 software. From this result analysis, the better impedance, gain in vertical and horizontal positions, and radiation pattern in H-plane and E-plane.

KEY WORDS: Circular patch antenna, X-rd, SEM.

Introduction:
In the recent decade, the Millimeter wave antennas like Microstrip patch antenna are reducing the expectation for developing technology. Several designing parameters are must considered for antenna designing such as Substrate type, dimension of the substrate (thickness, height,) and material Characterization like tangent loss, permittivity, permeability and Structure of atom arrangement, density and porosity.

The artificially structured composite materials that have been engineered to design of patch antenna, because of they have desired electromagnetic property. Meta Materials whose permeability and permittivity derive from their structure. Meta material antennas are highly miniaturized (electrically small), because they are distributing very easily. The purpose of this class of antenna is to launch energy into free space. The substrate materials are synthesized by using Sol-Gel route method. Then the Solid state materials are heated in microwave furnace at 800◦C. The RT-Droid plates have lower permittivity than other substrate. They have lower dielectric constant as 2.2.

While designing, the Substrate height is a vole parameter. If the Substrate height is less than 1mm, that design will produce the Surface wave loss. Since, the height has been maintained as 1.5mm or 1.6mm. The Dimension of the patch depends upon mainly two things. They are permittivity and operating frequency. The lower permittivity of substrate reduces the size of the antenna. Then resistance decides the Return loss of the antenna. If the Impedance match is correct as 50Ω.., the antenna will be radiating efficiently with low return loss. The Permittivity has calculated with the help of N4L meter. Loss tangent plays a vital role in antenna designing which affects both cost and performance of an antenna. Tangent loss is one of the positions of antenna in a particular angle. Here the lower Tangent loss is 0.02.

Material Characterization:
X-Ray Diffraction:
X-ray diffraction is one the method to analysis the material particle size and packing arrangement. These analyses have carried out by using x-rays. If the materials are tightly packed, the x-ray are gets reflected. Otherwise rays are passed through it.

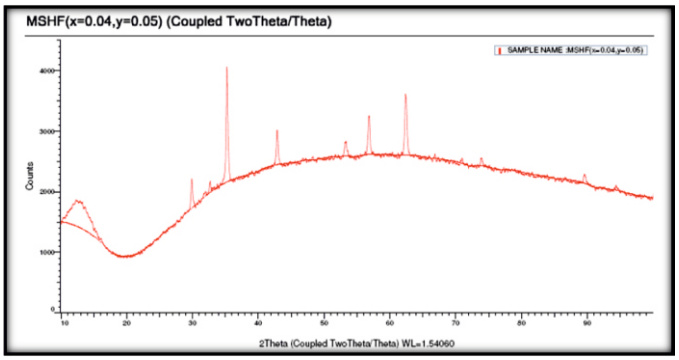

Figure 1

From these diffraction pattern, the more and more continues peaks are displayed. This highly peaks indicating the nano sized particles in the sample.

SEM:
The SEM is useful to study the Solid material's characterization and also capable of performing analyses of selected point locations on the sample; this approach is especially useful in qualitatively or semi-quantitatively determining chemical compositions crystalline structure, and crystal orientations.

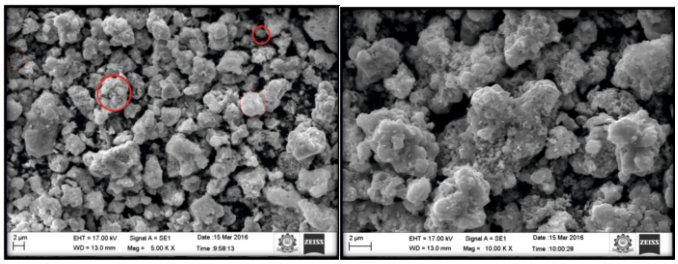

Figure 2

The above graph shows the SEM characterization of the sample. The red color circle indicated the selected point location.

Material Structure and Porosity Calculation
The material is tightly packed. That is proved by using Crystal maker and water saturation method.

Density:
Density is measure of how compact the mass in the substances. In the material sample, the atoms are arranged in cubic structure.

$$P=Mass/volume$$

The unit of this density is Kg/m^3.

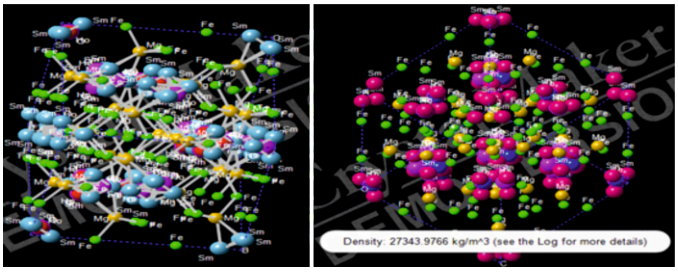

Figure 3

The above graph shows as the density could be described as the number of kilograms that 1 meter cubed of substance weighs.

Porosity:
The calculation is carried out by using water saturation method. The Wsat, Wdry, Wimmg of the sample are needed to calculate the porosity of the sample.

Calculation:
$W_{dry} = 0.763$

$W_{sat} = 0.894$

$W_{immg} = 0.581$

Pore Volume $= W_{sat} - W_{dry}/p_w$

Bulk Volume $V_b = W_{dis,wt}/p_w$

Porosity $\Phi = V_p/V_b$

$= 0.129/0.309$

POROSITY = 41%

From these Calculation the void space are very low than filled space. Hence its proved by this method.

Design of Circular patch antenna:
In patch antennas are designed at various design shape like rectangular, Square, U, E,-shape. Here, the proposed design is Circular patch antenna.

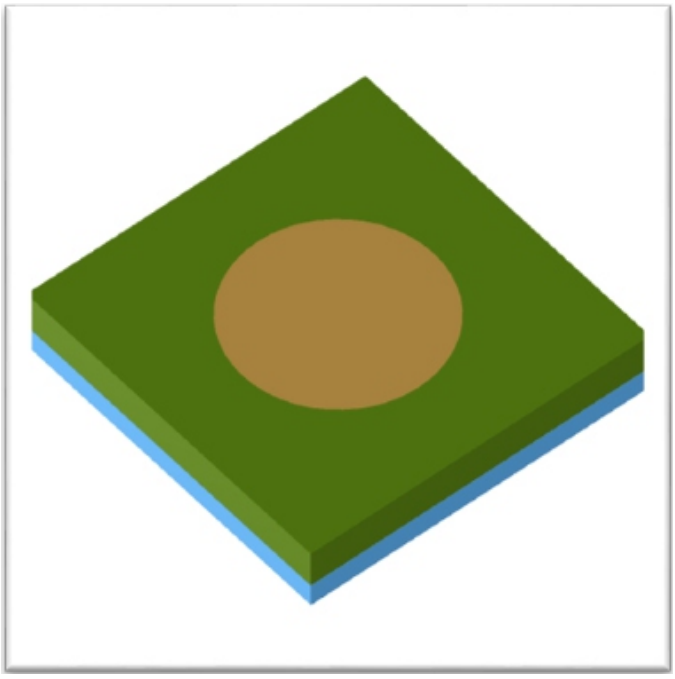

Figure 4

Substrate thickness should be chosen as large as possible to maximize bandwidth and efficiency, but not so large as to risk surface-wave excitation .The height of the Substrate should satisfy as follows

$$h \leq \frac{0.3c}{2\pi f r \sqrt{£r}}$$

Where "c" is the velocity of electromagnetic waves in free space.

Simulation Tool:
Antenna Magus
The Antenna Magus tool is very helpful to accelerated to antenna tool. That has lot of features and proposed designed to reference. The tools has lot of versions are available. Here, the proposed design is fabricated with help of V 5.0.1. After start of designing process, should calculate the permittivity, permeability, tangent loss, dielectric constant. Then operating frequency and resonance frequency are desired. If any doubt are in your design, just verify that the older designing projects. That tool had been invited by CST.

Circular Patch Antenna:
Several innovative projects are constructed with rectangular shape. It compared than rectangular patch has lower designing parameters. In the simulation tool have the Minimum value and maximum value for every parameter in antenna design.

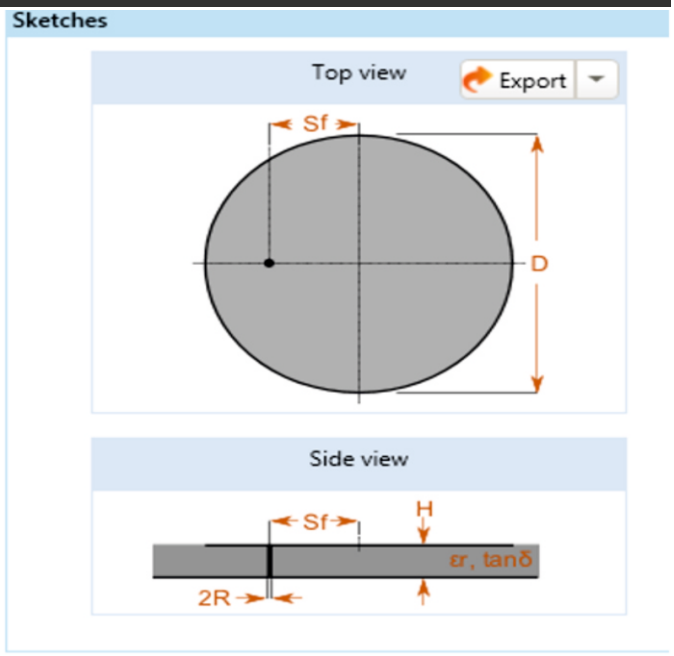

Figure 5

Design Parameter:

Parameter	quality
Operating frequency	3 GHz
Dielectric constant	2.2
Input impedance	50 Ω

Simulation Results:
Impedance Vs Frequency:
Depends upon the frequency the impedance is varied. That means the frequency and return loss both are inversely proposal.

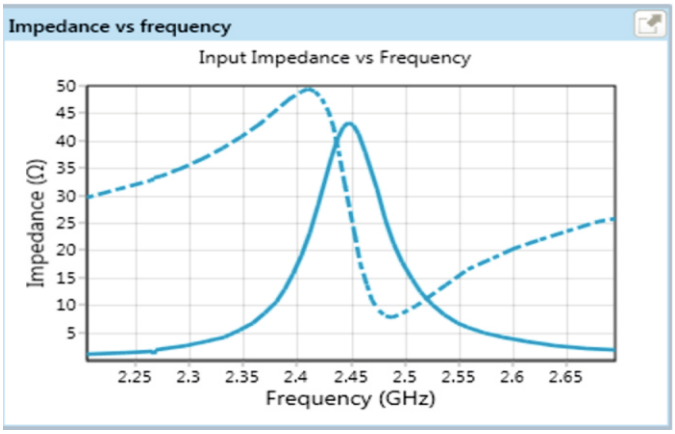

Figure 6

From this graph, the antenna have radiated at 2.45 GHz with 43Ω. These details are showed below in the graph.

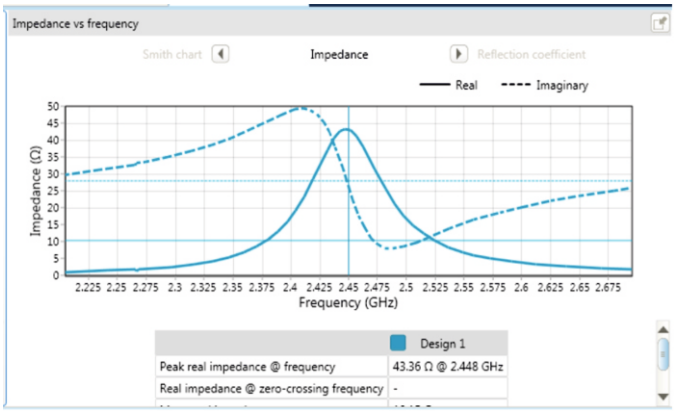

Figure 7

Gain:

The designing software tools shows two type of gain with respect the position such as horizondal gain vertical gain. Here, the verical gain have showed below.

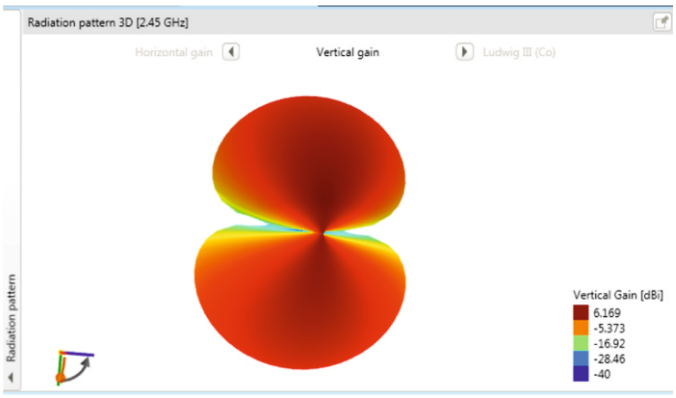

Figure 8

From these graph, the five colors are indicating the gain range with respect our distance radiating. The gain of the proposed design is 6.169dBi. The far field the range will be gradually decreased.

Radiation Pattern:

The radiating Capacity have displayed in both E-plane and H-Plane.

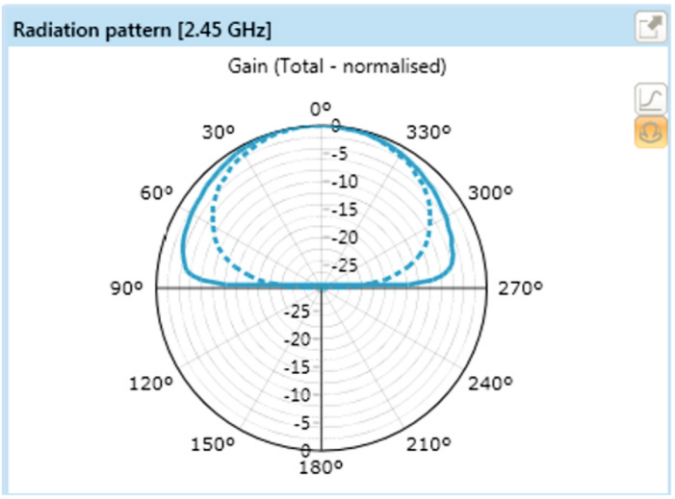

Figure 9

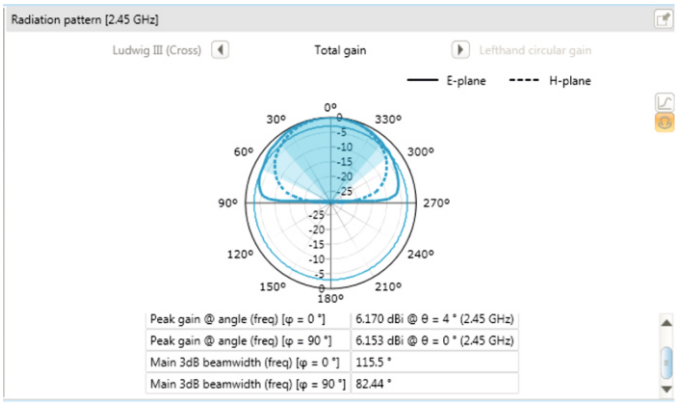

Figure 10

Conclusion:

In this paper, the circular patch antenna has successfully designed. These outputs are gain radiation pattern and impedance matching are gathered through graphical structure. The Meta Material has lower porosity, permittivity and density. Hence its proved with the help of crystal maker and water saturation method. The gain efficiency is 6.169 dBi in vertical position. The proposed design is surly implemented in bio medical application at 2.45GHz.

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