Sm- Gd doped Magnesium Ferrite for E-shaped Microstrip Patch Antenna

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ABSTRACT
The simulation study of E patch antenna parameters using IE3D for newly synthesised Sm-Gd nano ferrite coated over RT Duroid is presented in this paper. These simulated results for the center frequency of 5 GHz showed a Return loss of -20.35dB, VSWR of 1.21, the Directivity was 8.32 dBi and the Gain came to be -16.39dBi. These results were better than the results of Sm doped Mg ferrite.

Keywords: Micro strip E patch antenna; Sm Gd doped Nano ferrite; RT Duroid.

1.INTRODUCTION
In the present scenario there are numerous works going on microstrip patch antenna geometry and design. On this line ferrite materials have been synthesised to act as low-temperature cofired ceramics (LTCC) to be used as packaging modules for wireless applications [1-5]. In this paper we have coated the compound $MgSm_xGd_yFe_{2-x-y}O_4$ [6] over RT DUROID to act as a substrate for micro strip E patch antenna. The simulation studies were carried out using IE3D, it was seen that the Gain and VSWR has shown an increase for this material as compared to the Sm doped Mg Ferrite [7]. The reason for using Sm-Gd doped Mg ferrites was due to the lower value of (ε_r).

2.ANTENNA DESIGN & STRUCTURE
The dielectric substrate $MgSm_xGd_yFe_{2-x-y}O_4$ was used for the fabrication of E-shaped microstrip patch antenna. The resonant frequency f_r was kept as 5GHz and the. The dielectric constant(ε_r) of the material was 1.504 the thickness of the substrate (h) was taken as 1.0 cm to design patch antenna. Its characteristic parameters such as length L, the width w, and thickness h, are shown in figure 1. The field between the ground plane and patch is shown in figure 2. The width of the micro strip antenna was determined by the simulation using the following equation [6].

$$W = \frac{C}{2f_0\sqrt{\frac{(\epsilon_r + 1)}{2}}}$$

The actual length of the patch (L) was determined from
$L = L_{eff} - 2\Delta L$

The strip patch length and width were calculated using Ansoft designer SV2.10 version.

3.RESULTS & DISCUSSION
IE3D-Version12.0 (Zeland Software) an inte-grated full-wave electromagnetic simulation and optimization package for the analysis and design of the 3D and planar microwave circuits, and antennas has been used to design the microstrip patch antennas. It was also used to analyze 3D and multilayer structures of E-shaped antenna and to simulate and study the VSWR (Fig. 6,12,18,22), Directivity (Fig.7, 13,19,23), Gain (Fig.8,14,20,24) current distrib-utions (Fig. 10,16,26) as well as the radiation patterns(Fig 9,15,25). An evaluation version of this software was also used to obtain the results for different substrate thickness.S11 (Fig. 5,11,17,21).

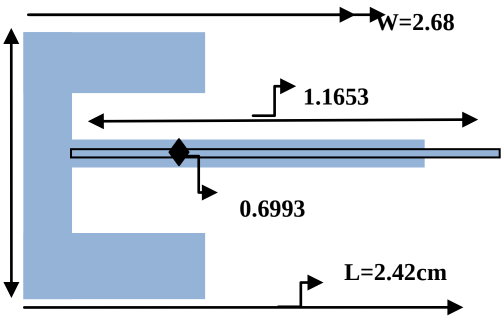

Fig 1 Block Diagram of proposed Antenna

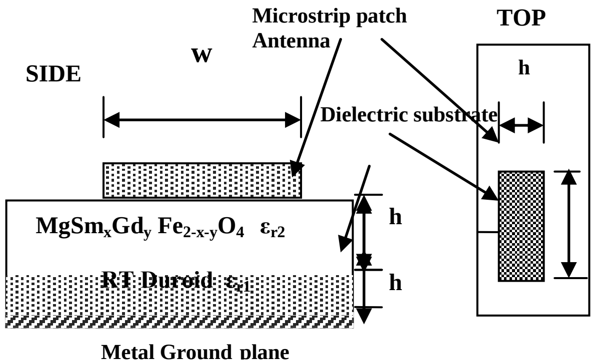

Fig 2 Side view of the microstrip antenna

Thickness 0.05cm

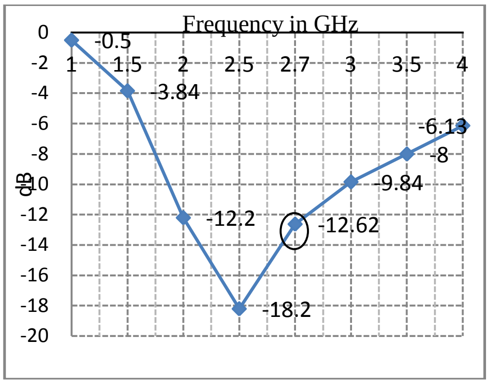

Fig 3 Return loss Vs Frequency (in GHz)

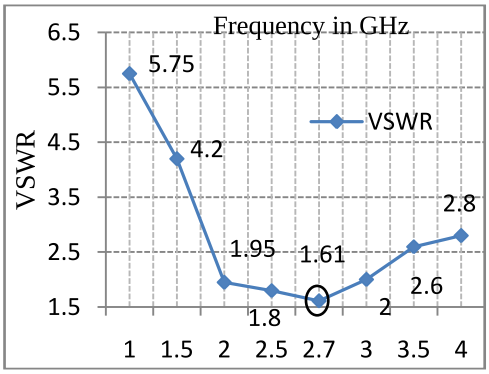

Fig 4 VSWR Vs Frequency (in GHz)

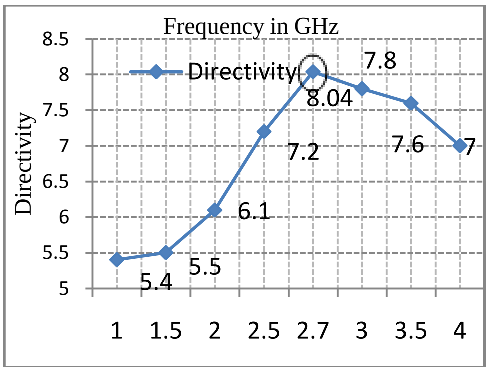

Fig 5 Directivity Vs Frequency (in GHz)

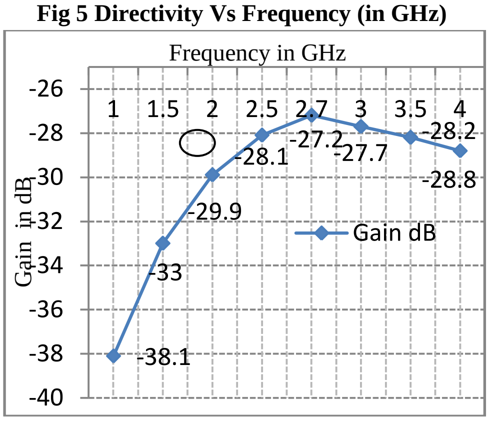

Fig 6 Gain Vs Frequency (in GHz)

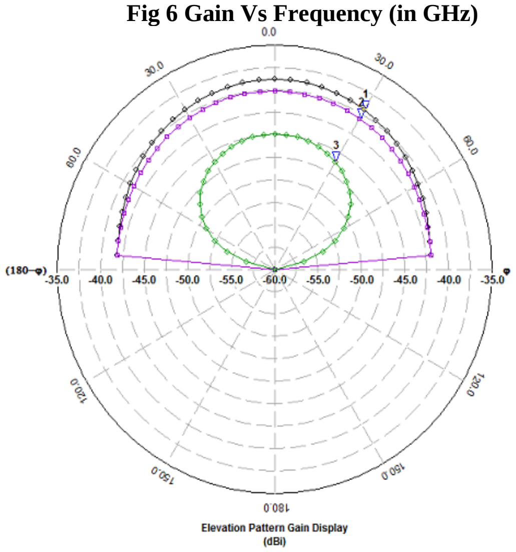

Fig 7 Radiation pattern of the antenna

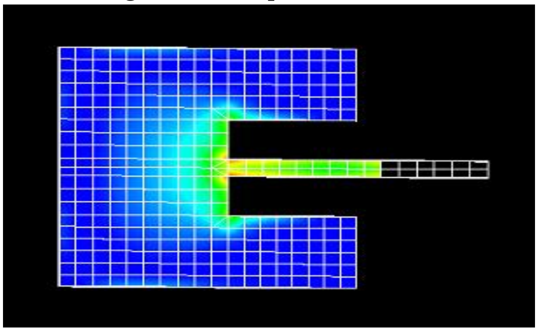

Fig 8 Current distribution of the antenna

Thickness 0.1cm

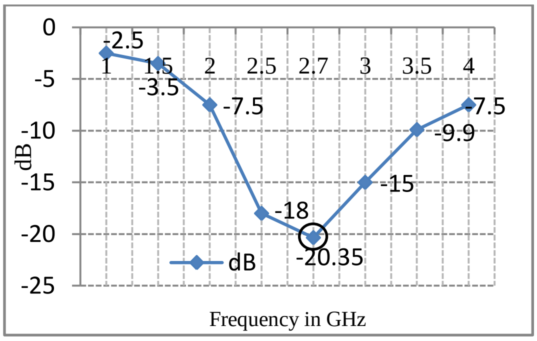

Fig 9 Return loss Vs Frequency (in GHz)

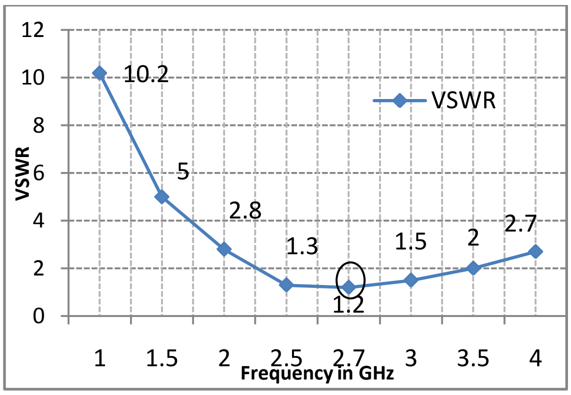

Fig 10 VSWR Vs Frequency (in GHz)

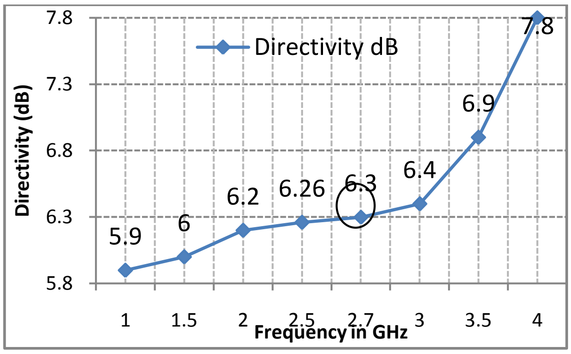

Fig.11 Directivity Vs Frequency (in GHz)

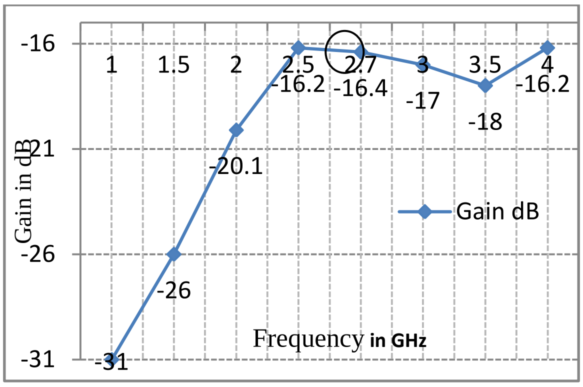

Fig 12 Gain Vs Frequency (in GHz)

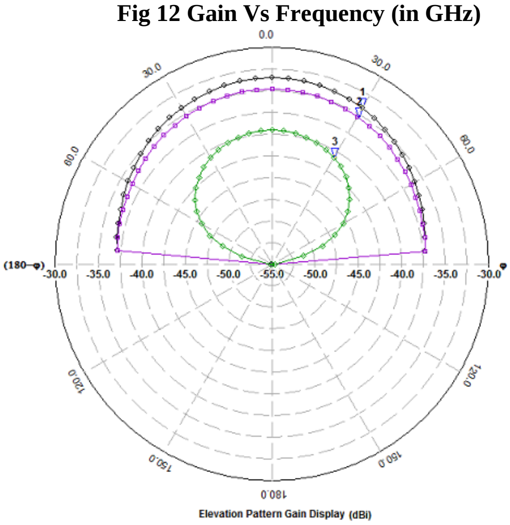

Fig 13 Radiation pattern of the antenna

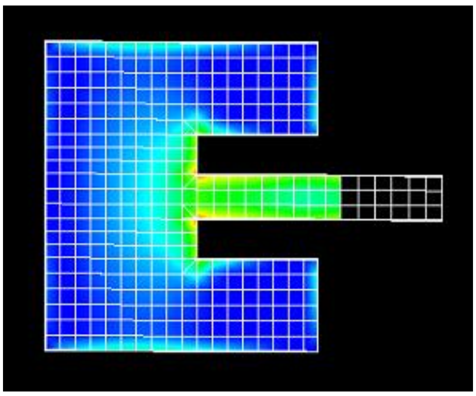

Fig 14 Current distribution of the antenna

Thickness 0.15cm

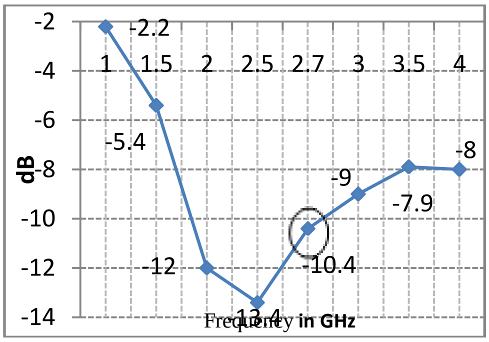

Fig.15 Return loss Vs Frequency (in GHz)

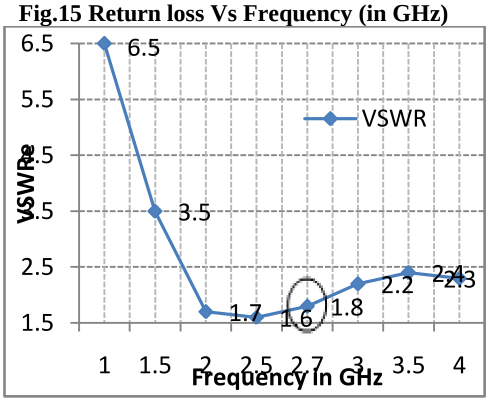

Fig 16 VSWR Vs Frequency (in GHz)

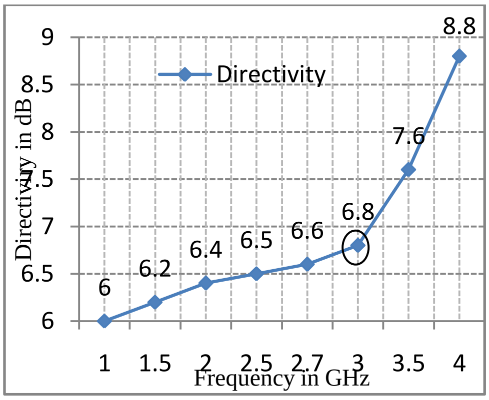

Fig 17 Directivity Vs Frequency (in GHz)

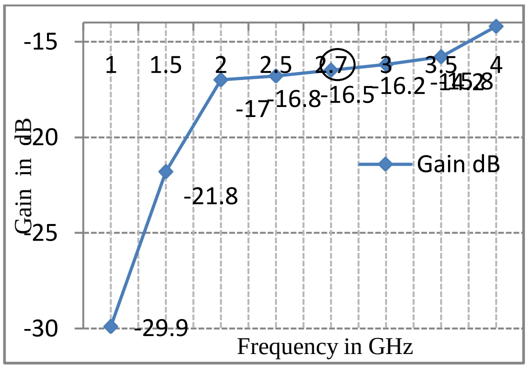

Fig 18 Gain Vs Frequency (in GHz)

Thickness0.2cm

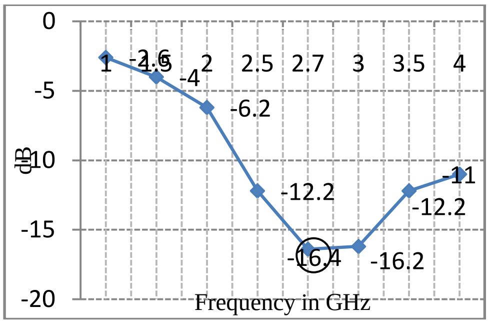

Fig 19 Return loss Vs Frequency (in GHz)

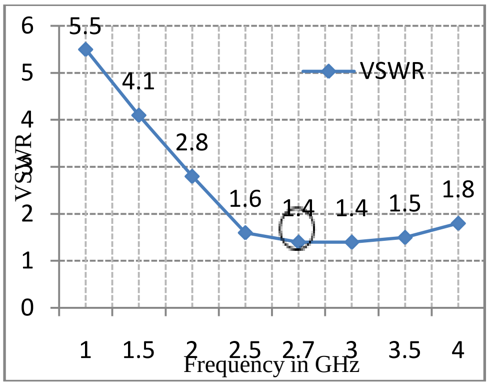

Fig 20 VSWR Vs Frequency (in GHz)

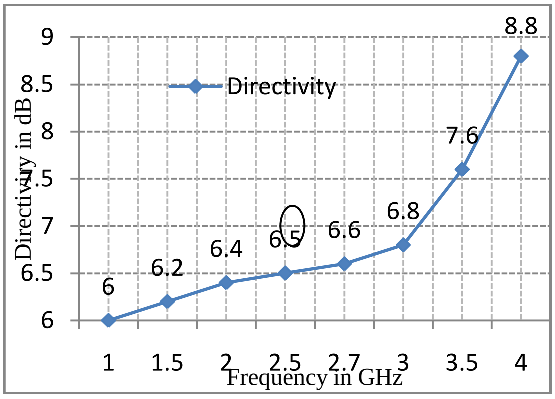

Fig 21 Directivity Vs Frequency (in GHz)

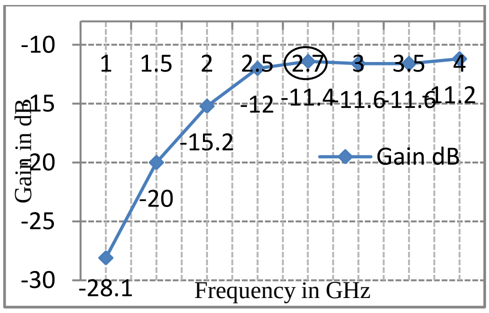

Fig 22 Gain Vs Frequency (in GHz)

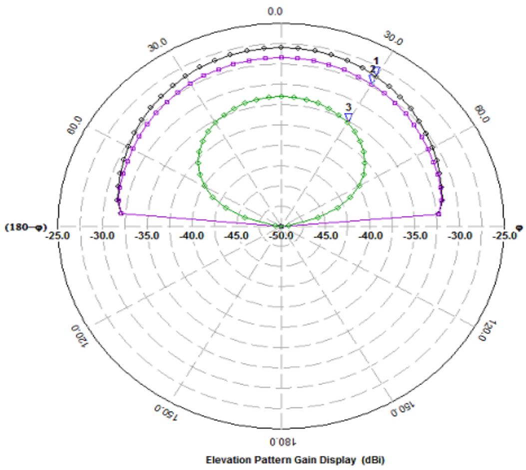

Fig 23 Radiation pattern of the antenna

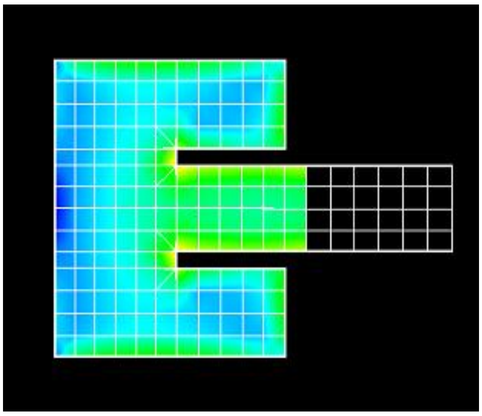

Fig 24 Current distribution of the antenna

Table 1:

S. N	Thickness (cm)	Return loss (dB)	VSWR	Directivity (dBi)	Gain (dBi)
1	0.05	-12.62	1.61	6.04	-27.20
2	0.1	-20.35	1.21	6.32	-16.39
3	0.15	-10.43	1.85	6.90	-16.49
4	0.2	-16.32	1.35	6.63	-10.84

As mentioned in table 1, the data for different substrate thickness, it is seen that the performance of E shaped microstrip patch antenna using $MgSm_xGd_yFe_{2-x-y}O_4$ was good for the thickness of 0.1cm,as compared to other thickness.

4. CONCLUSIONS:

In this work a Microstrip E shaped patch antenna designed by using $MgSm_xGd_yFe_{2-x-y}O_4$ coated over RT DUROID as substrate was simulated using IE3D Software. An optimization by changing the dielectric thickness and the reference planes/calibration lengths was conducted. Simulated results were satisfactory. At 0.1cm thickness we obtained -20.35dB return loss and VSWR value was 1.21, the Directivity came to be 8.32 dBi, the Gain was -16.39dBi. This thickness was found to be more effective than other thickness 0.05, 0.15 and 0.2cm. The overall performance of the proposed antenna can be improved by reducing the value of ε_r for the substrate material.

5. ACKNOWLEDGMENT

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