ANALYSIS OF RECTANGULAR DIELECTRIC RESONATOR ANTENNA USINGTMMTHERMOSET MICROWAVEMATERIAL WITHPROBE FED ARRANGEMENT

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ABSTRACT-ARDRA designed on Roger RT substratefor X-band frequency is proposed to operate at fundamental mode. In this paper, rectangular shaped TMM thermoset microwave material has been taken which will work as dielectric Resonator antenna. The paper presents the outcome of the experimental investigations performed on co-axial fed rectangular DRA. The simulation shows performance ofDRA.The proposed antenna is simulated by Ana soft HFSS.

KEYWORDS-*Dielectric Resonator Antenna,TMM, return Loss, RadiationPattern, HFSS.*

1. INTRODUCTION

Recently, DRA has been attaining immense popularity due to this features or properties like permittivity, low temperature coefficient, high radiation efficiency, large bandwidth, flexible feed arrangement, ease of excitation. In addition to this DRA is available in low cost. Due to such advantages, DRA has made up its place in world of wireless and other high frequency communication systems where performance of conventional antenna is restricted due to ohmic losses and surface losses. Dielectric Resonator as antenna was first introduced in the paper published in 1983[1-5] on cylindrical DRA. There are various applications of DRA in tracking,Wi-Fi, phones and communication devices. To achieve above said applications wide frequency range is required and that can be achieved dielectric constant changes with material changes and we generally want high dielectric constant so that we have high broadband.

In this paper, rectangular shaped TMM have been taken which work as dielectric Resonator antenna. These RDRAhas been excited using probe fed arrangement mechanism.

Rectangular shape is chosen because of its design flexibility and unlike other shapes, it provides improved degrees of freedom.

Co-axial probe excitation is the direct coupling into 50ohms system without need for a matching system. Probe can be either being located adjacent to DRAor can be embedded within it, in this paper probe has been placed adjacent. Probe length is generally chosen to be less than height of DRA to avoid probe radiation [5-10]. There are no simple equations to design the required probe height for a given set of dielectric resonator antenna dimensions and dielectric constant.

For high plated through hole reliability strip line and micro strip applications TMM thermoset microwave materials designed are ceramic, hydrocarbon, thermoset polymer composites. With wide range of dielectric constants and claddingsTMM laminates are available. The electrical and mechanical properties of TMM laminates combine many of the benefits of both ceramic and traditional PTFE microwave circuit laminates, without requiring the specialized production techniques common to these materials [11].

2.ANTENNA STRUCTURE AND ANALYSIS

The rectangular dielectric resonator antenna whose dimensions are lxbxh is located on a ground plane of dimensions 50x50 mm.

The resonance frequency f_o is obtained from the following transcendental equation [12-18]:

$$k_x \tan(k_x \tan k_x \, d/2) = \sqrt{(\varepsilon_{x-1})k_0^2 - k_x^2}$$

$$k_x^2 + k_y^2 + k_z^2 = \varepsilon_r \, k_0^2$$

Where $k_x (= \frac{\Pi}{a})$, $k_y (= \frac{\Pi}{b})$, and k_z represent wave numbers along x, y, and z directions within RDRA structure respectively [21]-[24].

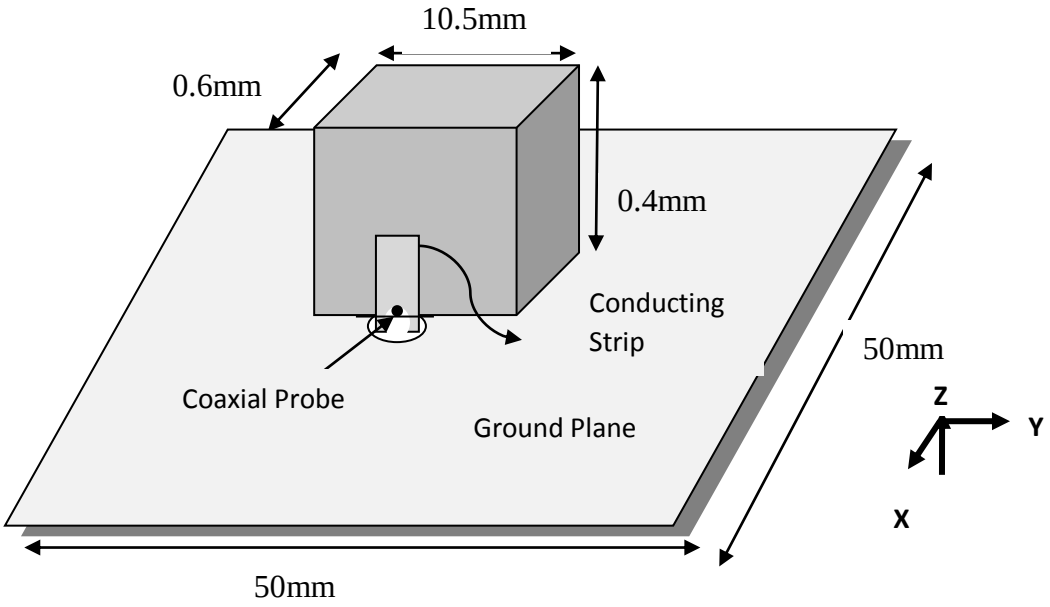

Fig.1.Antenna Geometry

3. ANTENNA DESIGN AND SIMULATIONS

TMM was used to design and fabricated prototype RDRA with dimensions 10.5mm x 0.6mm height 0.4mm and dielectric constant 13 to resonate at frequency 5.5 GHz and a loss tangent of tan $\delta < 0.008$. The antenna was mounted on a 50mm x 50mm infinite ground plane and excited by using probe fed arrangement.

The design values are implemented and then simulated as shown in fig.2& 3 using Anasoft HFSS to obtain optimum parameter values.

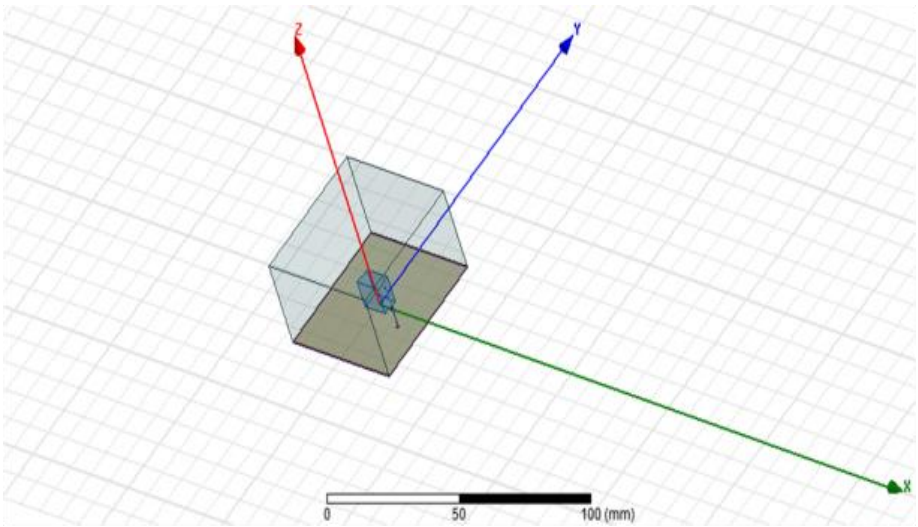

Fig.2.Constructed Probe Fed RDRA using Anasoft HFSS

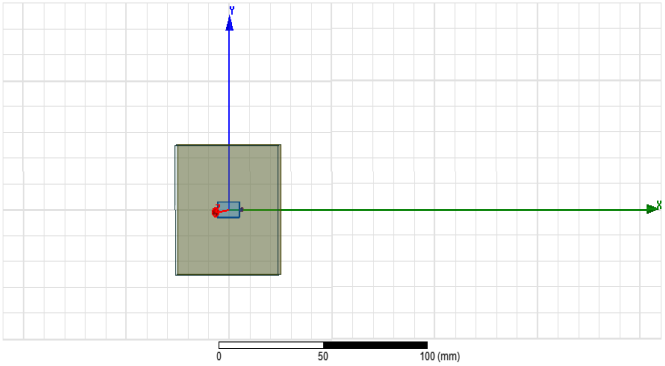

Fig.3. Constructed Probe Fed RDRA (Top View) using Anasoft HFSS

4. RESULT AND DISCUSSIONS

The reflection Coefficient (S_{11}) for proposed DRA has been shown in Fig.4.and Fig.5. shows 50Ω impedance matching at 5.5 GHz.AlsoFig.6. shows the radiation pattern showing Gain at 5.5 GHz of fabricatedPrototype DRA using TMM.

Based on dimensionsantenna was fabricated to validate analysis that have been presented in photographs of fabricated antennas are as illustrated in Fig.7(a) (b) &(c).

The antenna was measured and the result are consistent with simulated results.

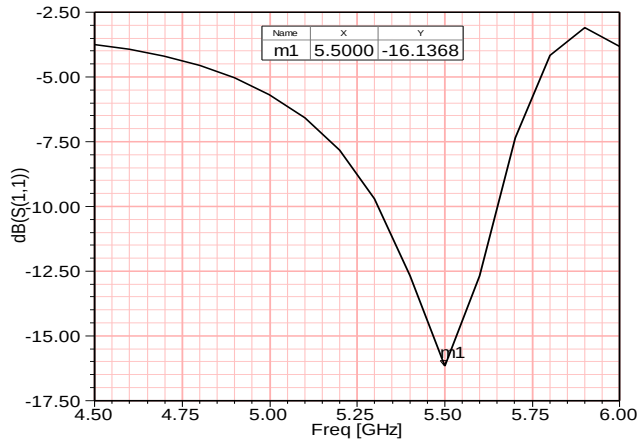

Fig.4. Measured $|S_{11}|$ of DRA prototype at 5.5GHz

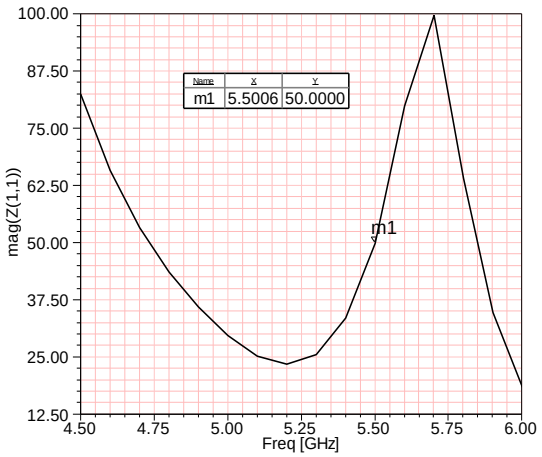

Fig.5. 50Ω Impedance Matching at 5.5 GHz

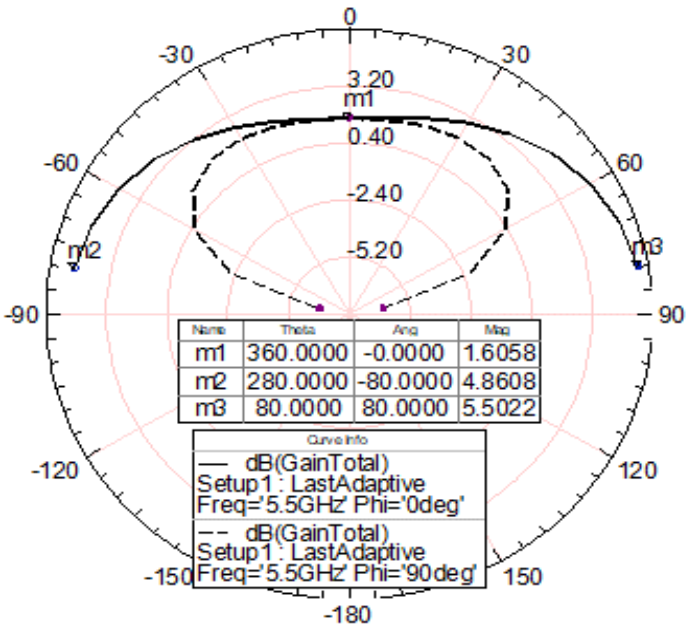

Fig.6. Simulated Radiation Pattern showing Gain at 5.5 GHz

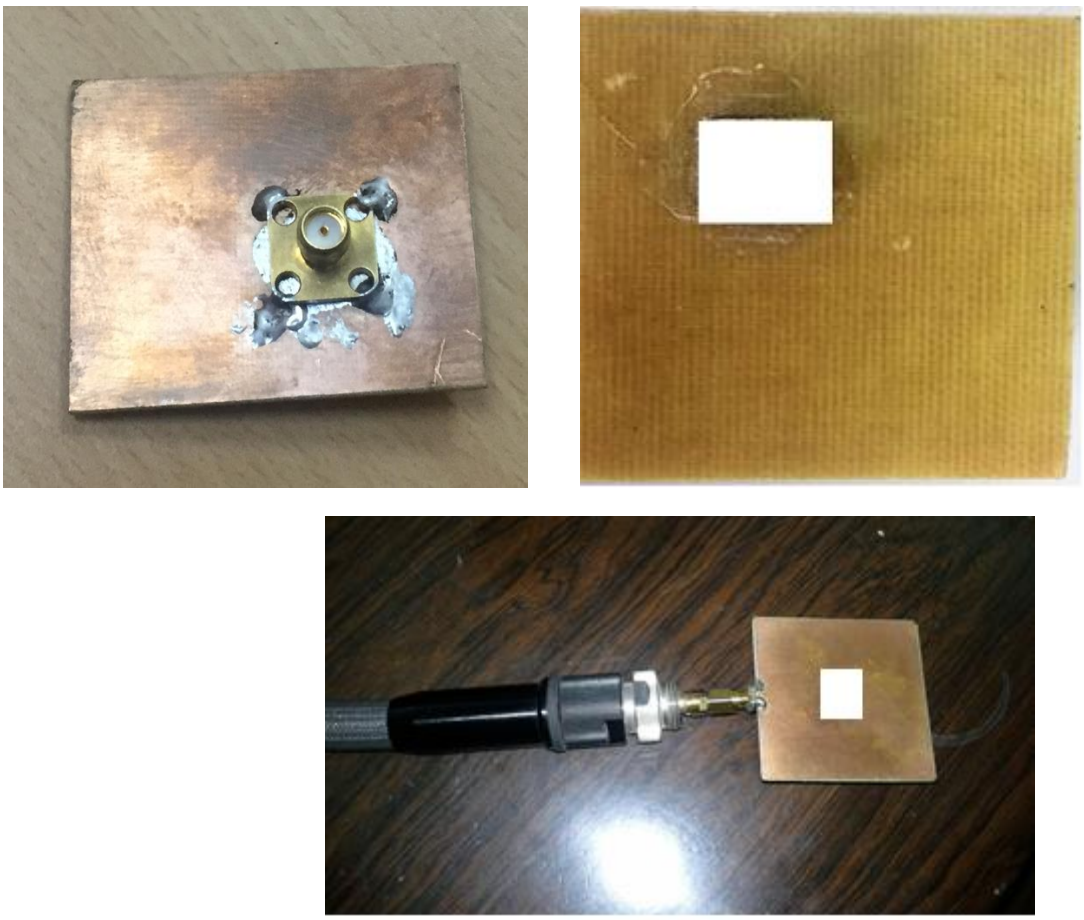

Fig.7. (a), (b) & (c) Fabrication of Prototype DRA using TMM

5. SUMMARY AND CONCLUSIONS

An inventive design has been presented. A TMM with dielectric constant 13 has been used to work like a DRA with similar radiation properties as for other kind of DRA [19-24] at 5.5 GHz frequency. Simulation and measured results of return loss and radiation pattern of prototype DRA have been shown.

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