Bandwidth improvement of Microstrip patch Antenna Based on Tio_2 Nano Particle

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Abstract— **In this communication we have demonstrate a prototype model to bandwidth improvement of microstrip patch antenna based on Tio_2 Nano filler. Microstrip patch antenna is wide utilized in wireless communication system. Patch antenna has variety of advantage over alternative antenna. It is low volume, thin profile configuration, light weight and easy to integrate with accompanying electronics which can made conformal but, Microstrip patch antenna has several limitations like narrow bandwidth and associated tolerance problem, lower gain. Patch antenna can be designed on simulation software like HFSS. This paper presented Design and simulation of microstrip patch antenna based on 10%, 20% and 30% Tio_2 Nano filler with Silicon Rubber substrate and analyzed result Bandwidth, Gain, Return loss etc has been presented. Derived results show that 10% Tio_2 Patch antenna is better for the improvement of Bandwidth of the antenna.**

Keywords-*Nano Filler(Tio_2); microstrip patch antenna**; a**nsoft HFSS**;** Band width; Gain*

I. INTRODUCTION

A microstrip antenna is used due to many advantages such as, small in size, low cost and an ease of fabrication, low weight but main disadvantage of microstrip patch antenna is its bandwidth. To overcome this limitation of microstrip patch antenna different bandwidth enhancement technique is adopted. In this substrate used 10%, 20% and 30% Tio_2 Nano filler with Silicon Rubber substrate and analyzed result Bandwidth, Gain, Return loss etc has been presented. Patch antenna are used for enhancement of bandwidth and it is better for improve the parameter of the antenna.

II. MICROSRIP PATCH ANTENNA

Microstrip patch antenna its simplest form consists of a radiating patch on one facet of a dielectric substrate and ground plane on the alternative aspect. The patch is fabricated from copper or gold and might take any viable form. The radiating patch and the feed traces are commonly photo etched at the dielectric substrate. Radiating patch conductivity is figuring out the antenna overall performance and gives the restriction of the antenna software. Microstrip patch antenna radiate fringing area between the outer edge the patch and ground plane. To enhance the fringing discipline from the patch, which account for the radiation, the width w of the patch is elevated. The fringing fields also are more suitable by using reducing the εr or with the aid of growing the substrate thickness h. Microstrip patch antenna uses microstrip patch with large width and substrate with decrease εr and thicker h.

III. DESIGN PROCEDURE

The below equation are used for the find the length L and width w of the patch using the parameter like height of substrate h ,the dielectric constant ε_r and resonant frequency f_r which are given in formula as:

STEP 1: Width of microstrip patch can be calculated below equation as:

$$w = \frac{c}{2f_0\sqrt{\frac{\varepsilon_r+1}{2}}}$$

STEP 2: Equation of effective dielectric constant as:

$$\varepsilon_{r_{eff}} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left[1+12\frac{h}{w}\right]^{1/2}$$

STEP 3: Equation effective length as:

$$L_{eff} = \frac{c}{2f_0\sqrt{\varepsilon_{r_{eff}}}}$$

STEP 4: Equation of the length extension as:

$$\Delta L = 0.412h \frac{\left(\varepsilon_{r_{eff}} + 0.3\right)\left(\frac{w}{h} + 0.264\right)}{\left(\varepsilon_{r_{eff}} - 0.258\right)\left(\frac{w}{h} + 0.8\right)}$$

STEP 5: Equation of actual length of patch as:

$$L = L_{eff} - 2\Delta L$$

III. ANTENNA CONFIGURATION

The Geometry proposed microstrip patch antenna presented work in fig.

Design Specification:

Table 1: Design specification with only Silicon Rubber Substrate

Patch material	Copper
Substrate material 1	FR4
Substrate material 2	Silicon Rubber
Substrate height1	1mm
Substrate height 2	5mm
Substrate dimension	100mm×100mm

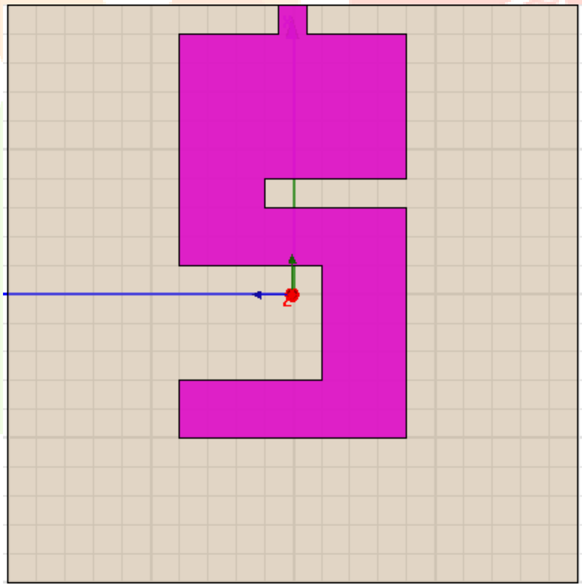

Fig.1 The Geometry of S shaped model (top view)

Above figure shows the geometry of S shaped microstrip patch antenna. In this microstrip patch line feed technique is used. Here above geometry dimension of the substrate 100×100mm^2 over shown in fig.1

- **Calculation of % Nano filler (Tio_2)**

Calculation of 10% Tio_2

1000ml	1 mole	=79.87
50ml	0.1	?

10% weight of Tio_2 = 50*0.1*79.87/1000*1

=0.39935 gm

Calculation of 20% TiO_2

1000ml 1 mole =79.87

50ml 0.2 ?

20% weight of TiO_2 = 50*0.2*79.87/1000*1

=0.7987 gm

Calculation of 30% TiO_2

1000ml 1 mole =79.87

50ml 0.3 ?

30% weight of TiO_2 = 50*0.3*79.87/1000*1

=1.19805 gm

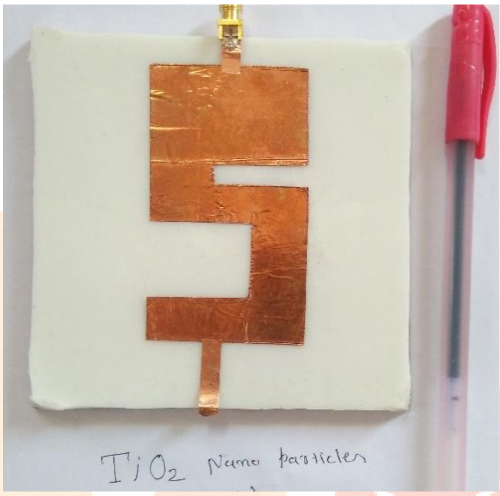

Fig.2 Fabricated model with Nano particle

IV. RESULT AND DISCUSSION

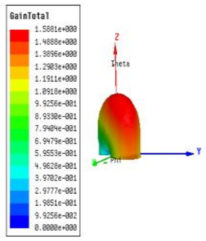

Fig.3 Total Gain polar plot S shaped microstrip patch antenna without TiO_2 particle

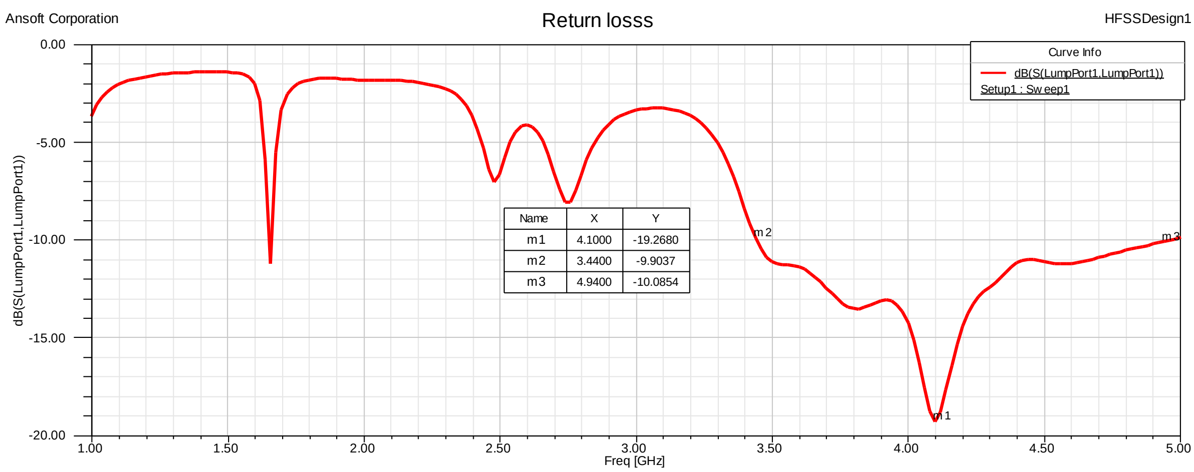

Fig.4 Return loss of S shaped microstrip patch antenna without TiO_2

Here, above fig.4 shows that S parameter of the antenna. It is shows that the return loss is -19.2680 at 4.1000 Ghz frequency .The negative return loss here depicts that the antenna have not many losses during the transmission.

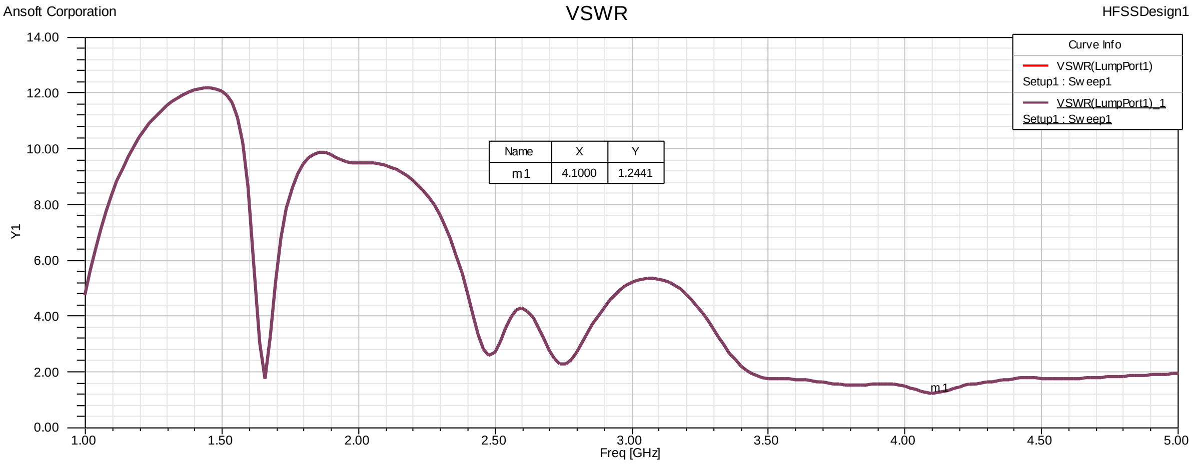

Fig.6 VSWR of S shaped microstrip patch antenna without Tio_2

The VSWR of the design shows that frequency band under observation. The value of observation is1.2441db at 4.1000 GHz frequency.

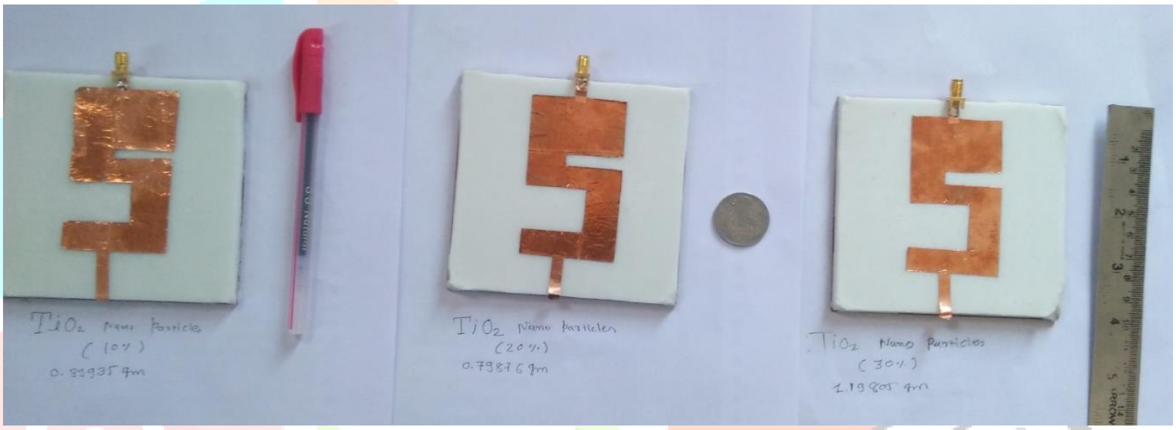

Fig.7 Fabricated S shaped model with 10%, 20% and 30% Tio_2 Nano particle

- **Measurement of 10%,20% and 30% Tio_2 model**

Fig 8. Set up of measurement 10% Tio_2 model

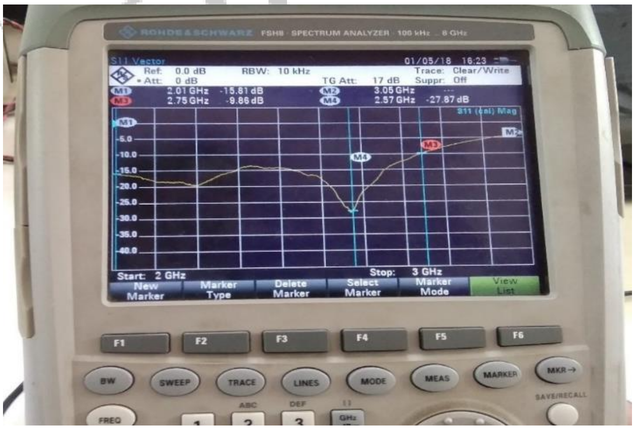

Fig 11. Return loss 10% Tio_2 model

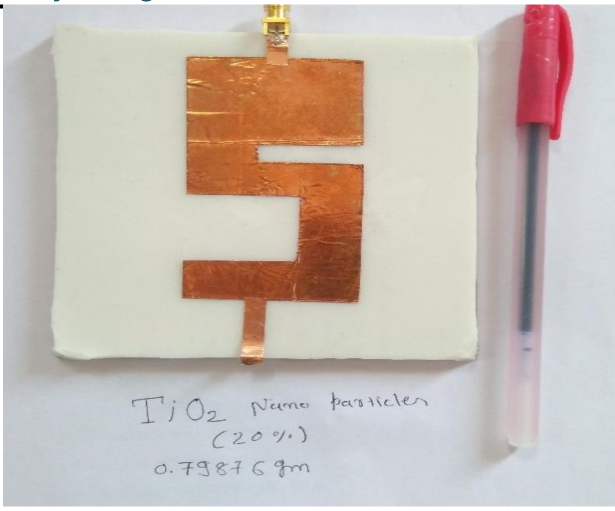

Fig 9. 20% TiO_2 model

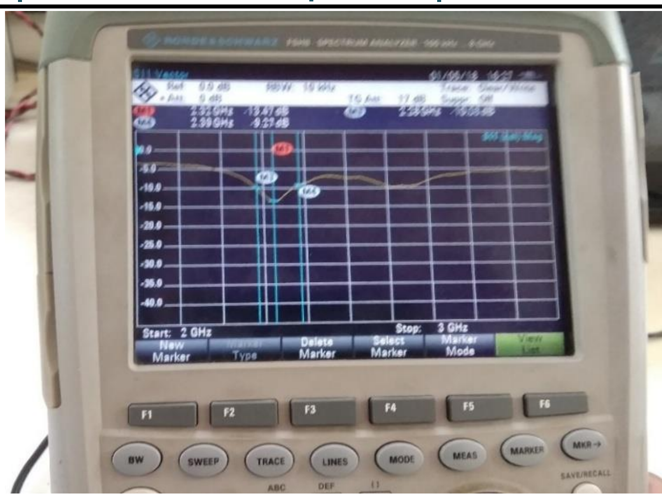

Fig 12. Return loss 20% TiO_2 model

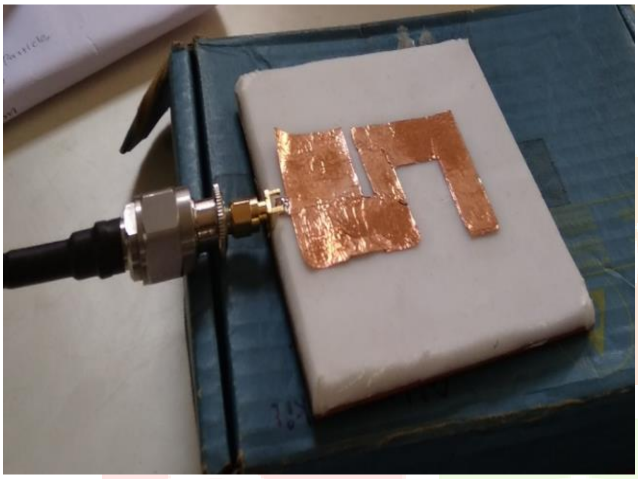

Fig 10. Set up of measurement 30% TiO_2 model

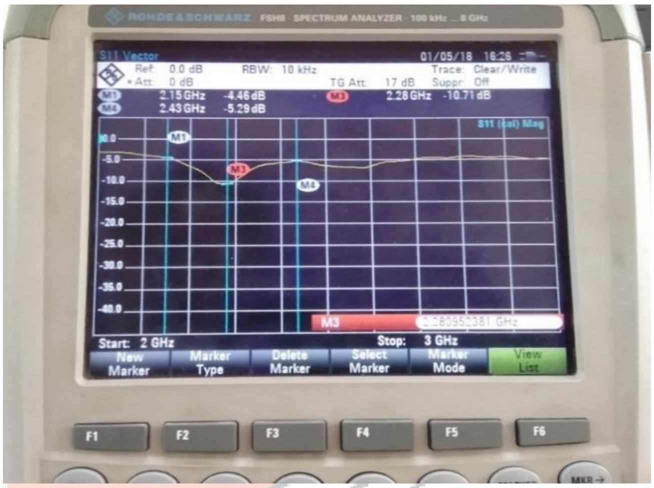

Fig 13. Return loss 30% TiO_2 model

V. COMPARE PROPOSED RESULT ANALYSIS WITH EXISTING RESULT

Parameter	Silicon Rubber Without TiO_2 **Simulated Result**	Silicon Rubber with 10% TiO_2 **Experimental Result**	Silicon Rubber with 20% TiO_2 **Experimental Result**	Silicon Rubber with 30% TiO_2 **Experimental Result**
Frequency (GHz)	4.10	2.57	2.32	2.28
Return loss (dB)	-19.26	-27.87	-13.47	-10.78
Bandwidth (MHz)	**1500**	**750**	**85**	**28**
VSWR (dB)	1.2441	1.084	1.538	1.813
Reflection Coefficient	0.109	0.040	0.212	0.289
Mismatch Loss (dB)	0.051	0.007	0.200	0.379

IV. CONCLUSION

In this paper, S shaped microstrip antenna using Silicon Rubber with 10%, 20% and 30% Tio_2 substrate has been design, simulate, optimize and analyzed using ANSOFT HFSS software. The performance of the design antenna was analyzed and compare with simulated result and different percentage of Tio_2 Nano filler in terms of bandwidth, gain, return loss, VSWR. Here the Optimized 10% Tio_2 S shaped result improve compare to the other result and Bandwidth of antenna improvement is good compare to other result.

V. REFERENCE

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