iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 Issue: V Month of publication: May 2018

DOI: http://doi.org/10.22214/ijraset.2018.5043

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue V, May 2018- Available at www.ijraset.com

Zinc Nanoparticles Loaded Rectangular Microstrip Antenna for Multiband Operation

Mahesh C P[1], Mohsina M Shaikh[2], Maheshwar Sharon[3], Madhuri Sharon[4]
[1, 2, 3, 4]*Department of Nanotechnology, Walchand Centre for Research in Nanotechnology and Bionanotechnology, Solapur, Maharashtra, India,*

Abstract: In this paper, a compact size rectangular microstrip antenna is designed and fabricated. To enhancement of bandwidth and multiband frequencies of microstrip antenna is done by loading zinc nanoparticles on radiating patch of rectangular. The characteristics of the antenna are obtained in terms of bandwidth, return loss, gain and radiation pattern these properties are compared with the conventional microstrip antenna. It is shown that by choosing suitable nanoparticles the bandwidth can be improved up to 16.66% as compared to conventional antenna with an bandwidth of 3.22%. This antenna may find its applications in Bluetooth, WLAN, WIFI IEEE 802.11, IMT (International Mobile Communication) and in radar systems. The results are discussed and presented.
Keywords: Rectangular microstrip antenna, Zinc nanoparticles, Bandwidth, Return loss, Gain and VSWR.

I. INTRODUCTION

The microstrip antennas are very popular in radar and satellite communication applications, due to their low profile, mechanically robust, relatively compact and light and possibility of dual frequency operation. They are inexpensive and easy to manufacture and can be conformable in planar and non-planar planes.

Unfortunately they have some limitations, specially narrow bandwidth [1]. But nowdays, wider bandwidth is required for the increasing demand of modern wireless communication systems. Generally each antenna performs its function at a single frequency, so different antennas that are needed for different applications will cause a limited space problem.

The Researchers think that multiband antennas provide solutions to relief from this problem where single multiband antenna can operate at many frequencies for different applications.

By applying fractal shape technique into antenna geometrics, multiband antenna can be constructed [2]–[6].]. a rectangular shaped with complex slot cutting dual-band microstrip antenna for Ku band application have been proposed average gain is not good [7]. To overcome above these problems, we have designed rectangular microstrip patch antenna to enhance bandwidth and multiband operation using zinc nanoparticles on the radiating patch of the proposed antenna.

II. ANTENNA DESIGN CONSIDERATION

The proposed design of the rectangular microstrip patch antenna is shown in Figure 1. This is consists by a rectangular patch with finite-size ground plane. The rectangular patch is situated top of the substrate and the ground plane is situated bottom of the substrate.

The design of rectangular microstrip antenna using economy cost glass epoxy substrate having dielectric constant $\varepsilon r = 4.2$. The rectangular microstrip antennas are made up of a rectangular patch with dimensions width (W) and length (L) over a ground plane with a substrate thickness (h) having dielectric constant (εr).

There are numerous substrates that can be used for the design of microstrip antennas, having their dielectric constants usually in the range of $2.2 \leq \varepsilon r \leq 12$. The ones that are most desirable for antenna performance are thick substrates whose dielectric constant is in the lower end of the range because they provide better efficiency; larger bandwidth loosely bound fields for radiation into space, but at the expense of larger element size.

All the parameters of proposed antenna are given in Table 1.

Table 1 Designed Specifications Of The Proposed Antennas

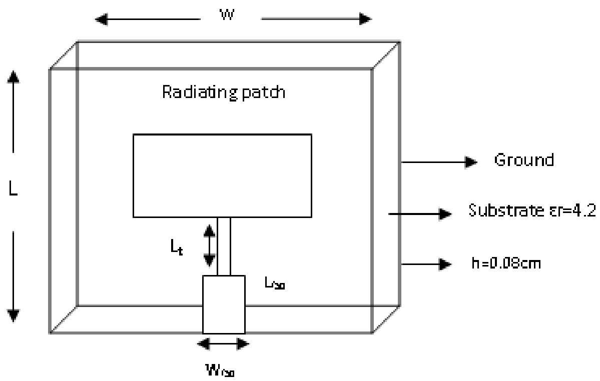

Figure 1: Geometry of RMSA

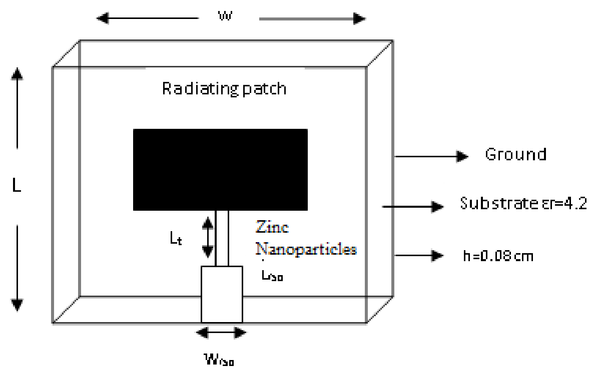

Figure 2: Top View of ZNRMSA

Further, the study is made by loading zinc nanoparticles on the radiating patch which provides extent to achieve multiband frequencies and high enhancement in bandwidth. The top view of zinc nanoparticles loaded rectangular microstrip antenna (ZNRMSA) is shown in Figure 2. The proposed antenna work is constructed using the computer software AUTOCAD to gain the best accuracy. The antenna is fabricated using the photolithography process.

III.EXPERIMENTAL RESULTS

The impedance bandwidths over return loss less than -10 dB for the proposed antennas are measured. The measurements are taken on Vector Network Analyzer (Rohde & Schwarz, German make ZVK Model No. 1127.8651). The variations of return loss versus frequency of RMSA and ZNMSA antennas are shown in Figure 3 and Figure 4. The experimental impedance bandwidth is calculated using the equation (1),

$$\text{Bandwidth } (\%) = \left[\frac{f_2 - f_1}{f_c}\right] \text{x}100\% \qquad (1)$$

where, f_1 and f_2 are the upper and lower cut off points of resonating frequency when its return loss reaches -10 dB and f_c is a center frequency between f_1 and f_2. The RMSA resonates at 6.2GHz with impedance bandwidth of 3.22% (6.05GHz –6.25GHz). From the Figure 4, it is found that the ZNRMSA resonates at eight bands of frequencies f_1, f_2, f_3, f_4, f_5, f_6, f_7 and f_8 with their corresponding bandwidths BW_1= 16.66% (2.1GHz - 2.5GHz), BW_2= 3.92% (5.00GHz –5.20GHz), BW_3= 7.01% (5.5GHz -5.9GHz) ,BW_4= 5.55% (7.00GHz-7.4GHz), BW_5= 6.41% (7.5GHz – 8.00GHz), BW_6= 3.57% (9.60GHz -9.95GHz), BW_7= 1.94% (10.20GHz-10.40GHz) and BW_8= 8.55% (11.00GHz-11.95GHz) respectively.

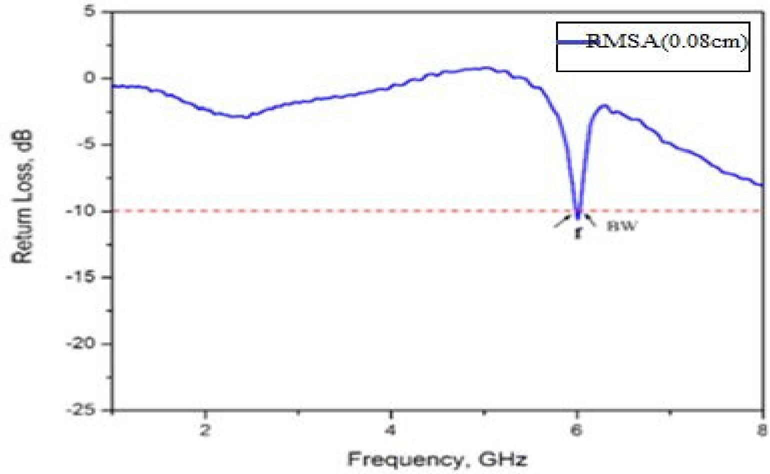

Figure 3: Variation of Return Loss v/s Frequency of RMSA

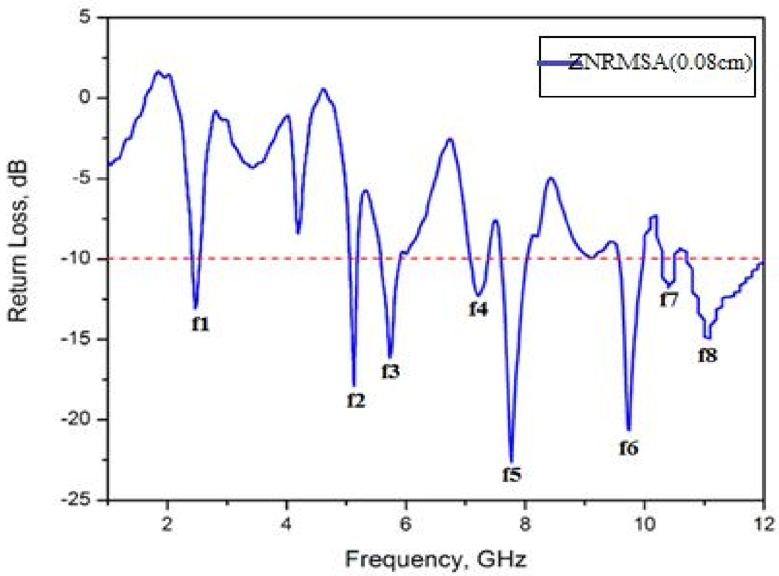

Figure 4: Variation of Return Loss v/s Frequency of ZNRMSA

The X-Y plane co-polar and cross-polar radiation patterns of RMSA and ZNRMSA are measured at their resonating frequencies and are shown in Figure 5 to Figure 6. These figures indicate that the antennas show broad side radiation characteristics.

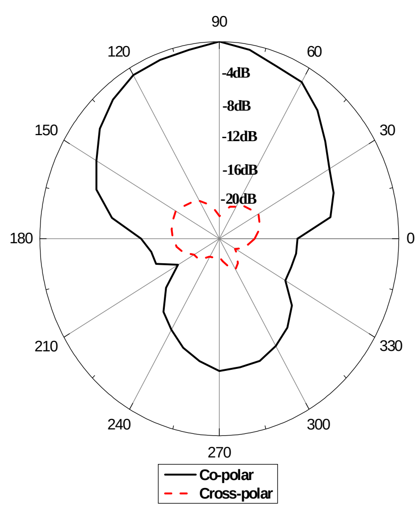

Figure 5: Radiation Pattern at 6.2 GHz

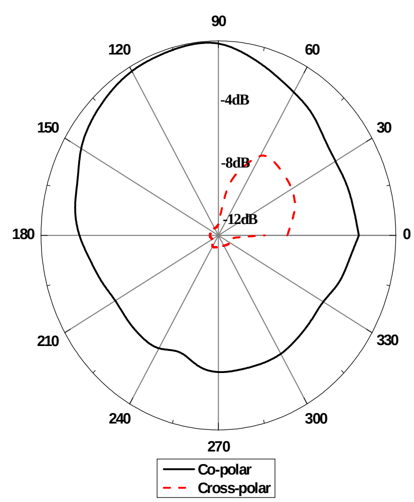

Figure 6: Radiation Pattern at 5.1 GHz

The gain of proposed antenna is calculated using absolute gain method given by the equation (2),

$$(G)_{dB} = 10\log\left(\frac{P_r}{P_t}\right) - (G_t)_{dB} - 20\log\left(\frac{\lambda_0}{4\pi R}\right)_{dB} \ dB \qquad (2)$$

where, Pt and Pr are transmitted and received powers respectively, G_t is the gain of the pyramidal horn antenna and R is the distance between transmitting antenna and antenna under test. The return loss, gain and VSWR of the antennas are also tabulated in Table 2.

TABLE 2
Calculated Return loss, Gain and VSWR

Antennas	Frequency in GHz	Return loss in dB	Gain in dB	VSWR
RMSA	6.2	-11	2.25	1.50
ZNRMSA	5.1	-18.5	5.45	1.12

IV. CONCLUSIONS

This paper concludes from above figures and tables that by loading zinc nanoprticles on the radiating patch of the proposed antenna has improved characteristics like bandwidth, gain and VSWR. All these performance measure results make this antenna suitable for the Bluetooth, WLAN, Wi-Fi and Radar applications.

REFERENCES

[1] R. Garg, Microstrip Antenna Design Handbook. Norwood, USA: Artech House, 2001
[2] A. Azari and J. Rowhani, “Ultra wideband fractal microstrip antenna design”, Progr.Electromag.Res.C, vol. 2, pp. 7–12, 2008
[3] M. P. Salmasi, F. Hodjat-Kashani, and M. N. Azarmanesh, “A novel broadband fractal Sierpinski shaped, microstrip antenna”, Progr.Electromag.Res.C, vol. 4, pp. 179–190, 2008
[4] M. Samsuzzaman, M. T. Islam, and J. S. Mandeep, “Design of a compact new shaped microstrip patch antenna for satellite application”, Adv. Natur.Appl.Sci., vol. 6, no. 6, pp. 898–903, 2012
[5] F. J. Jibrael, “Analysis and simulation of wire fractal antenna for multiband communication by method of moments technique”, Int. Rev. Model. Simul., vol. 3, no. 3, pp. 443–447, 2010.
[6] M. H. Ullah, M. T. Islam, M. S. Jit, and N. Misran, “A three-stacked patch antenna using high-dielectric ceramic material substrate”, J. Intell.MaterialSys.Struct., vol. 23, no. 16, pp. 1827–1832, 2012.
[7] M. HabibUllah and M. T. Islam, “Design of a modified W-shaped patch antenna on Al_2 O_3 ceramic material substrate for Ku-Band”, ChalcogenideLett., vol. 9, no. 2, pp. 61–66, 2012.