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Coplanar Waveguide Fed Circular Microstrip Monopole Antenna For Wearable Applications

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Abstract: Miniaturized body-worn antennas are essential for modern wireless communication systems. This paper presents a compact coplanar waveguide (CPW)-fed circular monopole antenna designed using a $Ni_{0.5}$ $Zn_{0.5}$ Fe_2O_4–linear low-density polyethylene (LDPE) magneto-dielectric composite substrate. The proposed material enables antenna miniaturization while reducing the influence of the human body on performance. The antenna is designed to operate around 6 GHz and experimental results show a reflection coefficient (S_{11}) of −30.16 dB at 5.50 GHz and a −10 dB bandwidth of 36.54% is observed.

Keywords: Coplanar waveguide (CPW), magneto-dielectric substrate, miniaturization, monopole antenna

1. Introduction

Wearable and body-centric wireless communication systems have rapidly growing and have created a demand for compact and efficient antennas which establishes a path for developing miniaturized antenna. Miniaturization is achieved by magneto-dielectric substrates due to their ability to reduce antenna size while maintaining its performance [1-8]. Geometrical modification of the antenna also adds to the size reduction of the antenna. Metal backing used in the most of the conventional antennas as reported which reduces the reduces the flexibility of the antenna system. CPW fed antenna makes it more flexible for wearable applications and gives ease of integration to other devices as no backside processing is required [9-18]. In this paper a CPW-fed circular microstrip monopole antenna is design using a $Ni_{0.5}$ $Zn_{0.5}$ Fe_2O_4–LLDPE composite substrate to address this challenge.

2. Design and fabrication of the designed antenna

CPW fed circular microstrip momopole antenna (CMMA), is designed by optimizing the feed gap parameter *d* and *g*, using the CST microwave studio. The dimensions of the CPW fed CMMA are tabulated in Table 1. The schematic of CPW fed CMMA is given in Figure 1. The fabricated antenna is shown in Figure 2.

Table 1. Design parameters of the CPW fed CMMA

r_0 (mm)	a (mm)	b (mm)	c (mm)	d (mm)	g (mm)	s (mm)
7.9	23.5	20	30	1	1	1

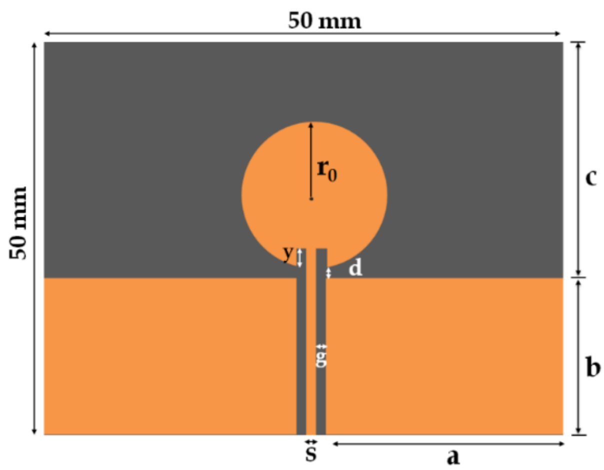

Figure 1. Schematic of CPW fed CMMA

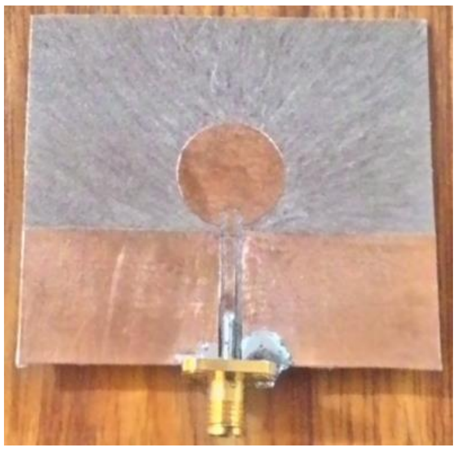

Figure 2. Fabricated CPW fed CMMA on magneto-dielectric substrate

2.1 Performance studies

The S_{11} parameter and E- and H- plane, co- and cross- polar radiation patterns at resonant frequency are shown in Figure 3 (a, b). The performance parameters are tabulated in Table 2.

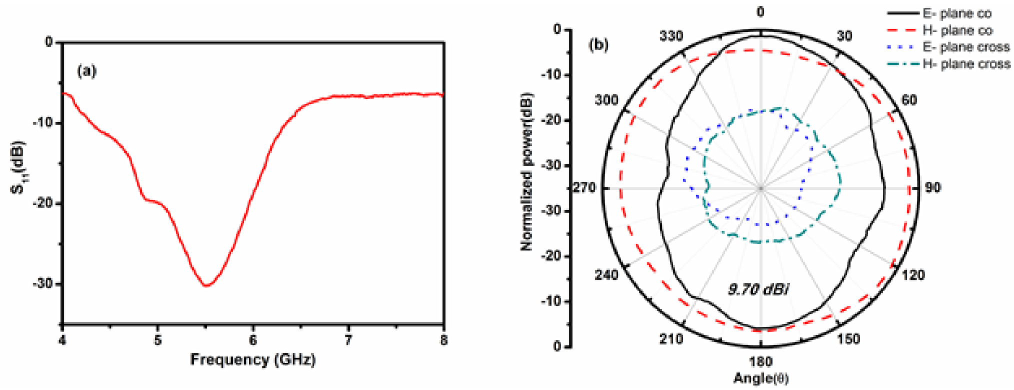

Figure 3(a) Measured S_{11} plot and (b) E- and H- plane, measured co- and cross- polar radiation patterns of CPW fed CMMA at 5.50 GHz

Table 2 Performance parameters of the CPW fed CMMA on magneto-dielectric substrate

Resonant frequency (GHz)	S_{11} (dB)	Directivity (dBi)	-10 dB bandwidth	
			GHz	%
5.50	-30.16	9.70	2	36.54

2.3 Analysis of the result:

A shift in the resonant frequency to the lower side of the resonating frequency is observed. The shift could be due to the coupling effect between the patch and the coplanar ground plane and fabrication tolerances [19-24].

3. Conclusion

CPW fed circular microstrip monopole antenna is designed and developed on the $Ni_{0.5}$ $Zn_{0.5}$ Fe_2O_4–LDPE magneto-dielectric substrate for wearable application. Reflection coefficient (S_{11}) of −30.16 dB at 5.50 GHz and a −10 dB bandwidth of 36.54% is observed for the designed antenna. Magneto-dielectric composite as substrate contributes to the size reduction of the antenna. The compact shape also makes it suitable for wearable applications.

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