ISSN (Print) : 2319-5940
ISSN (Online) : 2278-1021

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 2, Issue 8, August 2013

Effect of Different Semi Conductive Substrate Materials on a P shaped Wearable Antenna

Rajasree Hazra[1], Chandan Kumar Ghosh[2], S.K.Parui[3]

Dr.B.C. Roy Engineering College, Durgapur, India[1,2]

Department of Electronics and Telecommunication Engineering, Bengal Engineering and Science University(BESU), Shibpur, Howrah-711103, India [3]

Abstract- This paper presents the effect using different semiconductive substrate materials on a P shaped wearable antenna. This P shaped wearable antenna is designed for Body Centric Wireless Communication (BCWC) application at 2.45 GHz . Three types of semiconductive materials were selected : diamond, gallium arsenide, silicon. These three types of semiconductive materials are compared with duroid(tm) substrate. The results demonstrated a good agreement between simulated return loss, radiation pattern of all three substrates used for this wearable antenna. The simulated return loss and radiation pattern characteristics for all three types of substrates agreed reasonably well with this P shaped wearable antenna. Numerical study has been carried out, by using Ansoft HFSS V13 simulating software.

Keywords- Wearable antenna, body centric wireless communication, substrate materials, return loss, radiation pattern.

I INTRODUCTION

Recent years the demand for reconfigurable antennas have observed, these are used in a variety of applications, including sensors, filters, frequency meters and tuned amplifier etc [1]. These are generally used in many commercial applications in the industry, such as mobile satellite communications direct broadcast satellite services etc. Many researchers use the wearable antennas to demonstrate the BCWC applications as well as to investigate the performance of various types of wearable antennas in BCWC. In [2] design the first wearable active receiving antenna operating at 2.45 GHz is addressed for use in personal area networks. Slotted antennas for the application of WLAN become an important research point in the past decades and many different technologies for miniaturized antenna have been proposed [3]-[6], slotted antennas for ISM band become a hot research point in the past decades and many technologies for miniaturized antenna have been proposed [7]. Dimensions of the microstrip patch has been calculated, based on transmission line model [8]. The width and length of the microstrip patch has been estimated by [9], the substrate based on duroid(tm) of dielectric constant 2.2 has been taken in this design. It is very helpful to understand the interaction and performance of the antenna and the communication system for BCWC. In this paper a new wearable antenna is used for BCWC operating at the frequency 2.45 GHz as a P shape wearable antenna with micro strip line feed. A numerical study has been done, to find out the exact feed location, this feed location is found at (-44.59,1.85,0).

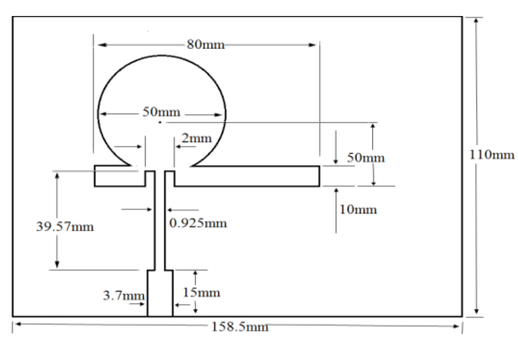

Figure 1: Geometry of the P-shaped wearable antenna.

BCWC has been given a great attention in recent years, due to the advances of wireless technology. The advent of textile antennas has open doors for the emergence of body-worn antenna systems embedded in known as “smart clothes”[10]. Textile antenna is very suitable for on body radio communication as it is very flexible, comfortable to be integrated into clothing[11] and also offers a low cost and easy to manufacture. This research focuses on the investigation of the effect of different semiconductive material based substrates on the performance of a wearable antenna in terms of return loss and radiation pattern characteristics. The performance of the wearable antenna is compared to a conventional duroid(tm) based substrate antenna at 2.45 GHz. Three types of semiconductive materials were selected : diamond, gallium arsenide, silicon. This results may be happened due to the relative permittivity characteristics of these materials. The relative permittivity of

ISSN (Print) : 2319-5940
ISSN (Online) : 2278-1021

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 2, Issue 8, August 2013

duroid (tm), diamond, gallium arsenide, silicon are described below in TABLE 1.

TABLE 1
RELATIVE PERMITTIVITY OF DIFFERENT SUBSTRATE MATERIALS

Substrate Material	Relative Permittivity
Duroid(tm)	2.2
Diamond	16.5
Gallium arsenide	12.9
Silicon	11.9

II RESULTS AND ANALYSIS

TABLE 2 summarizes the comparison of centre frequency between simulated wearable antenna using different types of substrates. From TABLE 3 and Figure 2 , it can be observed that some amount of upward frequency shift occurred with the utilization of different types of substrates. Gallium arsenide based antenna showed the worst upward frequency shifting than conventional antenna.

TABLE 2
CALCULATED CENTRE FREQUENCY OF DIFFERENT SUBSTRATE MATERIAL BASED ANTENNA

Substrate Material	Centre Frequency
Duroid(tm)	2.325
Diamond	2.24
Gallium arsenide	2.525
Silicon	2.61

TABLE 3
CALCULATED RETURN LOSS OF DIFFERENT SUBSTRATE MATERIAL BASED ANTENNA

Substrate Material	Return loss
Duroid(tm)	-17.5
Diamond	-5.75
Gallium arsenide	-4
Silicon	-4.25

From Figure 2, it can be seen that there is a good agreement between diamond, gallium arsenide, silicon substrate based antennas and conventional antenna. However, diamond, gallium arsenide, silicon substrate based antenna produced 11.75 dB, 13.5 dB and 13.25 dB lower than conventional antenna respectively. From TABLE 3 the result exhibited that three substrates based antennas(diamond, gallium arsenide, silicon) produced -5.75 dB, -4 dB, -4.25 dB return loss respectively. This results may be happened due to these substrate materials relative permittivity characteristics. Figure 3, Figure 4, Figure 5 and Figure 6 show the simulated radiation patterns for diamond, gallium arsenide, silicon substrate material based antenna respectively.

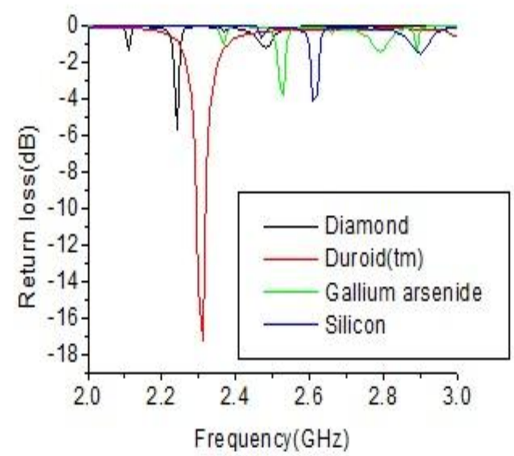

Figure 2: Simulated return loss for different substrate materials based antenna

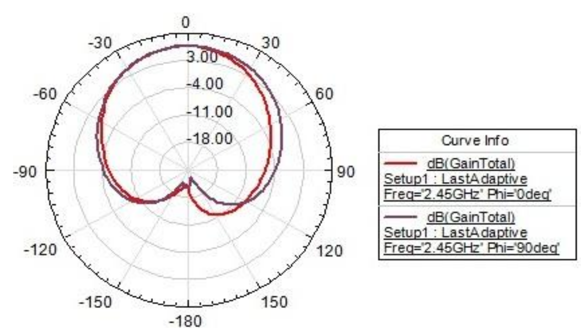

Figure 3: Simulated radiation pattern for diamond substrate material based antenna

ISSN (Print) : 2319-5940
ISSN (Online) : 2278-1021

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 2, Issue 8, August 2013

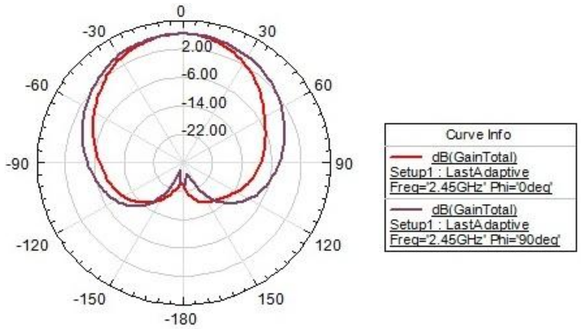

Figure 4: Simulated radiation pattern for duroid(tm) substrate material based antenna

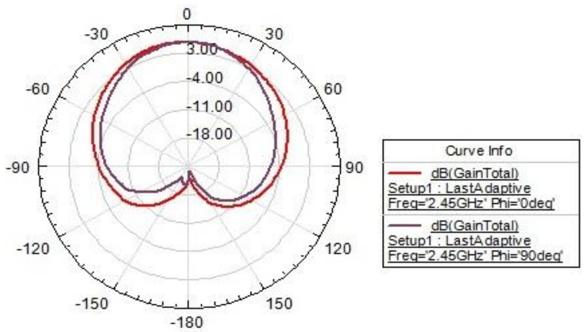

Figure 5: Simulated radiation pattern for gallium arsenide substrate material based antenna

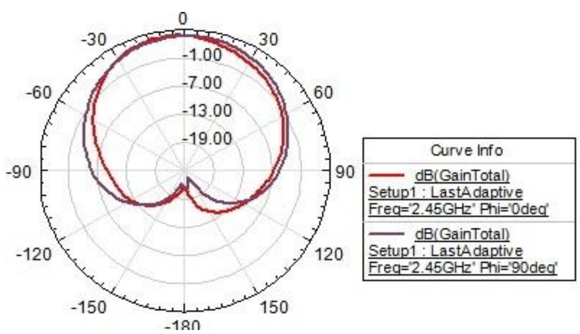

Figure 6: Simulated radiation pattern for silicon substrate material based antenna

III CONCLUSION

The investigation of the effect utilizing three different substrate materials for P shaped wearable antenna is presented in this paper. The return loss and radiation pattern characteristics of all four types substrates P shape wearable antennas were studied. The result exhibited that all three substrates(diamond, gallium arsenide, silicon) based P shape wearable antenna are compared to a duroid (tm) based P shaped wearable antenna.

ACKNOWLEDGEMENT

The authors like to acknowledge Dr. B. C. Roy Engineering College, Durgapur, India and Bengal Engineering and Science University(BESU), Shibpur, India for providing necessary support during the research work.

REFERENCES

[1] Pozar, D. M., Microwave Engineering, Addison-Wesley, New-York,1990.

[2] Frederick Declercq and Hendrik Rogier. 2010. Active Integrated Wearable Textile Antenna with Optimized Noise Characteristics. I IEEE Transaction on antenna and propagation. 58(9): 3050-3054.

[3] Ang, B. K. and B. K. Chung, "A wideband E-shaped microstrip patch antenna for 5–6 GHz wireless communications," Progress In Electromagnetics Research, PIER 75, 397–407, 2007.

[4] Chandan Kumar Ghosh, Biswarup Rana, Susanta Kumar Parui "Design and development of E-shaped array antenna using Defected Ground Structure at 5.25 GHz band" Progress in 2nd Annual International Conference IEMCON 2012.

[5] Ge, Y., K. P. Esselle, and T. S. Bird, "E-shaped patch antennas for high-speed wireless networks," IEEE Trans. Antennas Propagat., Vol. 52, No. 12, 3213–3219, Dec. 2004.

[6] T. A. Denidni and N. Hassaine , "Broadband and high-gain E-shaped microstrip antennas for high-speed wireless networks" Progress In Electromagnetics Research C, Vol. 1, 105–111,2008.

[7] Ahmed Al-Shaheen " New Patch Antenna for ISM band at 2.54 GHz" Progress in ARPN Journal of Engineering and Applied Sciences, VOL. 7, NO. 1, JANUARY 2012

[8] W.L.Stutzman. Antenna Theory & Design. John Willy & son's ine Second edition 1998.

[9] R.A. Sainati CAD of micro strip antenna for wireless applications. Artech House, Inc.1996

[10] J. Lilja, P. Salonen and P. de Maagt, "Characterization for conductive textile materials for softwearantennas," 2009 Antennas and Propagations Society International Symp., June 2009, pp. 1-4.

[11] I. Locher, M. Klemm, T. Kirstein and G. Troster, "Design and characterization of purely textile patch antennas," IEEE Trans. On Advanced Packaging, vol. 29, no. 4, June 2006, pp. 777-788.

BIOGRAPHIES

Rajasree Hazra received the B.Tech degree in Electronics and Communication Engineering in the year 2011 from West Bengal University of Technology, India. She is now doing M.Tech. degree in Electronics and Communication Engineering from West Bengal University of Technology India. Her current research interests include the micro strip antennas, wearable antennas, Body centric wireless communication, DGS.

Chandan Kumar Ghosh received the B.Sc (Hons) degree in Physics and B.Tech. degree in Radio physics and Electronics from University of Calcutta in the year 1987 and 1990 respectively. He did M. Tech. degree in Microwave Engineering in the year 2003, from Burdwan University, India.From 1991 to 1995, he worked as Development Engineer in Sonodyne Electronics Co. Pvt. Ltd. and from 1996 to 1999 he worked as Assistant Manager (R&D) in Sur Iron & Steel Co. Pvt. Ltd. From 2000 to 2009 he was associated with the department of Electronics & communication Engineering of Murshidabad College of Engineering & Technology and from Aug'10 he is in Dr. B. C. Roy Engineering College, Durgapur, India and presently holds the post of HOD in Electronics and Communication Engineering Deptt. He published more than 30 contributory papers in referred journals and international conference proceedings. His current research interests include the Array antenna, MIMO antenna, DGS, EBG etc.

Susanta Kumar Parui received the B.Sc degree in Physics and B.Tech. degree in Radio physics and Electronics from University of Calcutta in the year 1987 and 1990 respectively. He did Master and Ph. D in Microwave Engineering from Bengal Engineering and Science University, Shibpur, India . From 1993 to 2000, he worked as Instrument Engineer in Process control Industries. Since 2000, he is associated with the department of Electronics and Telecommunication Engineering of Bengal Engineering and Science University, India and presently holds the post of Assistant Professor. He was awarded post doctorial fellowship from Royal Academy of Engineering, U.K in the year 2009. His current research interests include the planar circuits, antennas, SIW, DGS, EBG and Meta materials. He published more than 40 contributory papers in referred journals and international conference proceedings.