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Wide Band Terahertz On-Chip Antenna for Terahertz Frequency Application

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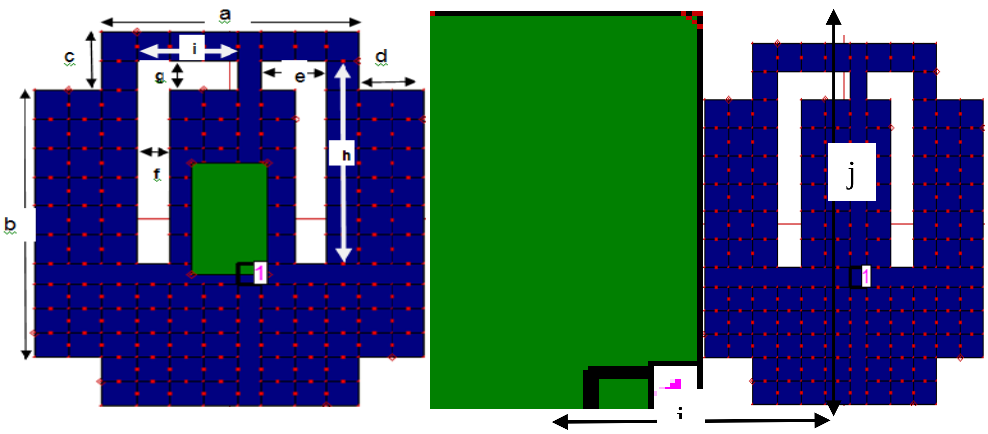
Abstract
The planned microstrip patch associate degree antenna on Si substrate in CMOS technology is proposed, the highest of the proposed antenna is loaded with form shape, and also the reflector is ground. The antenna is fed at the middle of the exciting patch, The antenna is compact and simply made-up through photolithography. The substrate employed in the antenna is SI whose permittivity is 12.5. The microstrip patch antenna is operated in an exceedingly THz frequency starting from twenty two to fifty GHz. The antenna is operated in a hybrid mode, thanks to this the gain of an antenna is to be improved, and such modes show the -10 dB information measure furthermore as -3db gain and radial asymmetry of a planned antenna. The antenna is operated in an exceedingly THz that is appropriate for wide gain and high bandwidth for a terahertz frequency application. The antenna is loaded with a via hole to once more improve and befits the tuned frequency for various applications. The dimension of the via hole is 1.6mm (1600 micrometer). The excited patch and reflector are separated by a feeding probe or SMA connective of fifty ohms. The resistance matching between supply to load is completed through loading the open wire of dimension 1.6mm,

Index Terms—CMOS, Rectangular patch antenna,Micro strip patch, terahertz (THz), wideband

I. INTRODUCTION

The terahertz antennas are widely used in security aspects like high-speed data communication, short-range detection of targets, medical emergencies like cancer detection, and many more. [1-4]. The terahertz is generally varied between microwave and infrared spectrum. The frequency generally used in a terahertz is 0.1 to 10 THz [5-9] .desktop. In THz applications, the proposed antenna is small and lower, the device is used to reduce the parasitic effect due to a single component used with no external wire bonding because of this it is used in various applications where the mutual coupling is less [6] This paper From previous work the antenna is used in radio communication is in on-chip. The substrate used in an antenna is silicon substrate (εr = 11.7~11.9). Most of the power from the reflected and is directed into the substrates, the most important is to be back radiation and lower gain because the performance of an antenna is lower down [8]. However, for high substrate constant and large thickness silicon material confine large power and results from the electromagnet waves serving on a substrate. Due to this, the radiation pattern is distorted and degrades the antenna gain. As a result, predictable on-chip antennas, revel in large losses, distorted patterns, and advantage reduction, that's on common restrained to zero dBi [10]. For enhancing the advantage and radiation parameters, exceptional strategies were reported. One of the easy strategies is used to mirror the floor aircraft taken into consideration as a protect to put off the impact of losses in a substrate [11]-[12].The answers consist of synthetic magnetic conductor arrangement [13]-[14], close to to the floor loss silicon-primarily based totally substrates [15] or GaAs [16] , Hollow silicon substrate [17], silicon lenses [18]-[19] and three-D antenna [20]. These strategies are efficient, however additionally with insufficient antenna advantage or greater cost, it isn't suitable for mass production. The Dielectric resonator antenna (DRA) is an opportunity antenna to enhance the advantage of the on-chip antenna and performed about a better advantage this is greater than 8dbi as consistent with preceding work. As a result, predictable on-chip antennas, experience huge losses, distorted patterns, and gain reduction, which is on average limited to 0 dBi [10]. For improving the gain and radiation parameters, different techniques have been reported. One of the simple techniques is used to reflect the ground plane considered as a shield to remove the effect of losses in a substrate [11]-[12].The solutions include artificial magnetic conductor arrangement [13]-[14], near to the ground loss silicon-based substrates [15] or GaAs [16] , Hollow silicon substrate [17], silicon lenses [18]-[19] and 3D antenna [20]. These techniques are efficient, but also with inadequate antenna gain or more cost, it is not appropriate for mass production. The Dielectric resonator antenna (DRA) is an alternative antenna to improve the gain of the on-chip antenna and achieved approximately a higher gain that is more than 8dbi as per previous work. [21]-[25].But the DRA is designed only for single band operation, but also it has a narrow bandwidth and it is difficult to design a such antenna for terahertz frequency due to the miniature size. [21], [23]-[25], recently, a chip-scale Dielectric Resonance Antenna that is operated at a very high frequency operated at 280 GHz was presented [26], the proposed antenna is designed and simulated to achieve a stable frequency range, stable radiation pattern, and high gain but in previous work, the directivity has not come in research but in our proposed work we will work on this and achieved better directivity as compare to previous work. However, the design is very simple and suitable for THz frequency. The antenna is simulated in IE3d Software Section II. The planned antenna and its 3D animation are to be displayed and determined that the pattern is stable. The simulations result show that the −10 decibel electrical resistance information measure and 3-dB gain bandwidth are 55%. Meanwhile, the radial asymmetry is concerning nine dB. As per the literature survey, it's the wide band for on-chip antenna operating with the simplest information of the author. In section III the measured leads to the computer code are then illustrated in Section IV. II Antenna Design

The proposed antenna for wideband in THz is shown in Figure 1. The antenna with different dimensions of an antenna with defected ground plane and the radiating plate is as shown in figure1. The proposed antenna design by using a silicon substrate of 1.6mm thickness and the permittivity is (εr = 11.7~11.9), the proposed structure is simulated by IE3D software



(b) (c)

Fig 1. Design of the proposed antenna (a) Top view of (b) Radiating Patch, (c) Ground Plane

Table1 Design specifications [5]

Parameters	(mm)	Parameters	(mm)
a	8	g	1
b	10	h	7
c	2	i	2.5
d	2	j	3.8
e	2		
f	1		

The size and shape of the proposed antenna are proven in fig-1. The antenna is truncated on the nook and includes slots to enhance the benefit in addition to directivity. A figure, (a) indicates the pinnacle view of an antenna, (b) indicates the radiating patch or interesting patch, and (c) indicates the defected floor plane. The antenna separated radiating patch and interesting patch via way of means of a silicon substrate, while the antenna is coaxial, or 50 ohms feeding is used. At a better frequency, it's far without problems switching at a totally excessive price due to the frequency utilized in a THz.

Table1. As shown above, the various dimensions of the planned antenna**.**

III Antenna Simulation and Measured Results

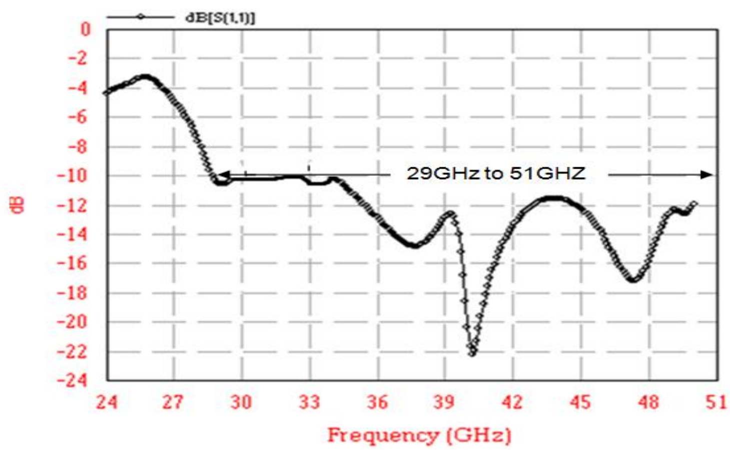


Fig2 Simulated Reflection Coefficient versus frequency plot of the proposed antenna

From Fig 2, it is clear that the antenna reflection is very less from load to source at frequency ranges from 29GHz to 51GHz and the antenna is stable for this frequency range. The projected antenna is during a single-band operation. The antenna is simulated in IE3d and also the VSWR bandwidth of an antenna is 55% of single band operation. The dip of the come back loss of the proposed antenna is -22 dB. By ever-changing the position or by concentrical feed line, we can change the bandwidth of an antenna, but by properly setting the feed point and slot area we can improve or the antenna as per our required frequency band.

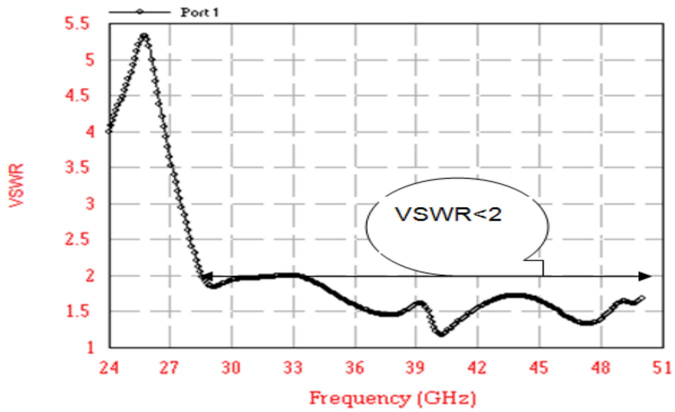


Fig 3 Simulated Results for VSWR versus frequency plot of the proposed antenna

The VSWR and frequency response of an antenna is as shown in Fig.3. The voltage standing wave is stable or less than 2 for the frequency range 29 to 51 GHz. According to Fig 3, it is shown that the VSWR bandwidth of the proposed antenna is 55% and as per the previous paper, it is 5% more achieved as per the simulation result. The proposed antenna is suitable for 5G applications and all other applications which is required a band of 29GHz to 51 GHz

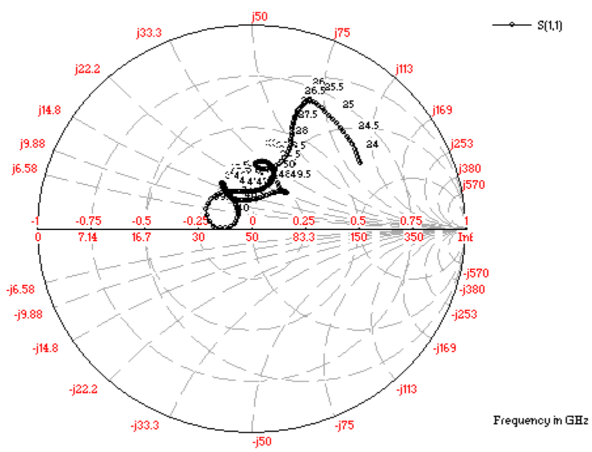


Fig 4 Simulated Results for Switch Chart of the proposed antenna

The fig is shown the inductive loading of the proposed antenna, the inductive matching is done, and the complete graph is shifted to the upper part of the chart, so it is shown that the antenna is inductive loading and resonance at 29 to 51 GHz.

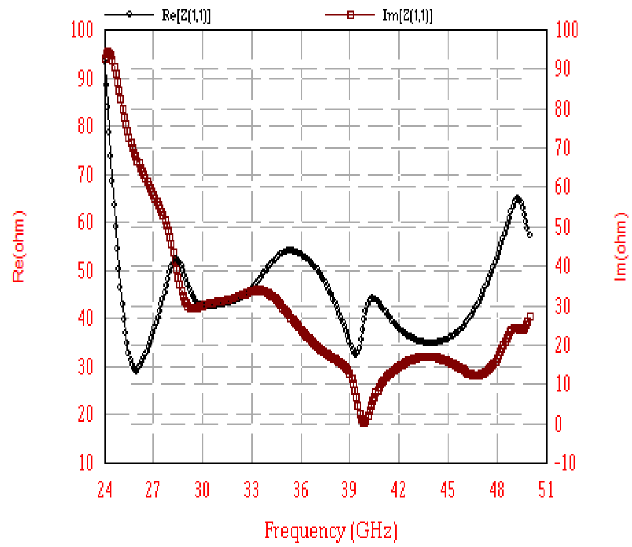


Fig 5 simulates Results for real and imaginary resistance of the proposed antenna

The working principle of the proposed antenna, input resistivity Z11 and input resistance R11 are planned in Fig. 5. The resonances of an antenna from frequency twenty nine to fifty one gigacycle per second are observed, wherever the resonance is outlined as a most resistance and nil electrical phenomenon and the other way around

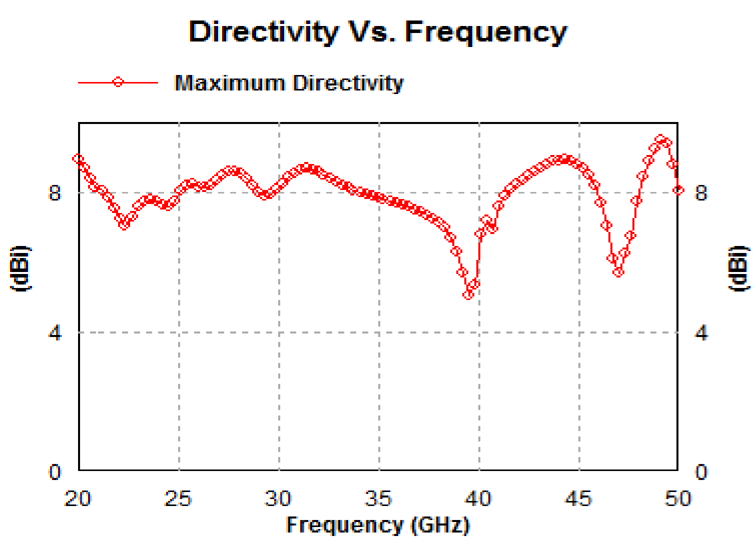


Fig 6 Simulated Results for Directivity of the proposed antenna

The simulation result for the proposed antenna directivity is shown in Fig 6. The antenna is simple in structure and obtained higher directivity compared to previous work. The directivity of an antenna is approximately 9 dBi from 29 to 51 GHz. The directivity of the antenna is obtained from the beam area. The beam area and directivity both are inversely proportional to each other, the mean directivity increases with decreasing in beam area.

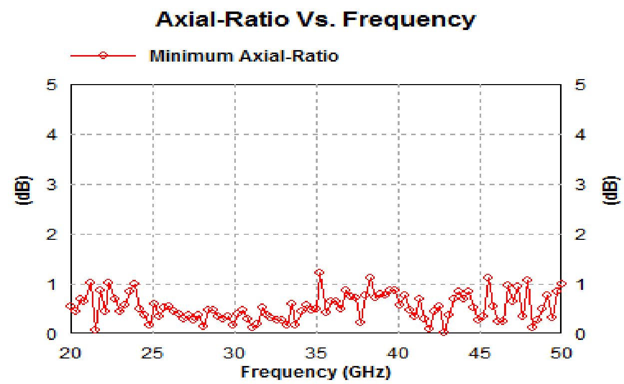


Fig 7 Simulated Results for axial ratio of the proposed antenna

The axial ratios are also enhanced by using the slotting structure.The Reactive electrical phenomenon surface structure is employed to get totally different axial ratio points as shown in Fig 7. From fig, it's clear that the planned antenna works as a linear and circular polarization.

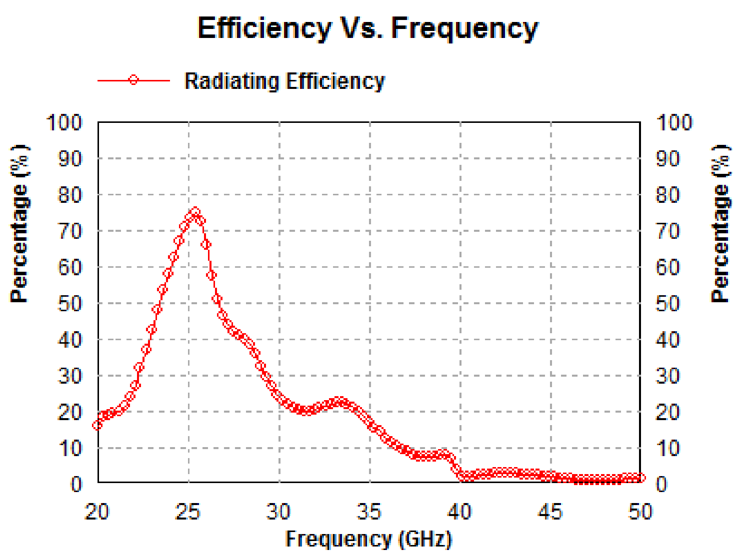


Fig 8 Radiation efficiency and antenna efficiency of the proposed antenna with respect to frequency

The far field radiation pattern is obtained by using (R>> 2D2/λ). where the D is the directivity of the antenna, the efficiency of an antenna is as shown in Fig 8 (a) and 8 (b). From Fig 8 it is clear that the proposed antenna is satisfactory operated in multi Frequency and an antenna efficiency of an antenna is approximately 80% and the radiation efficiency of an antenna is 90%

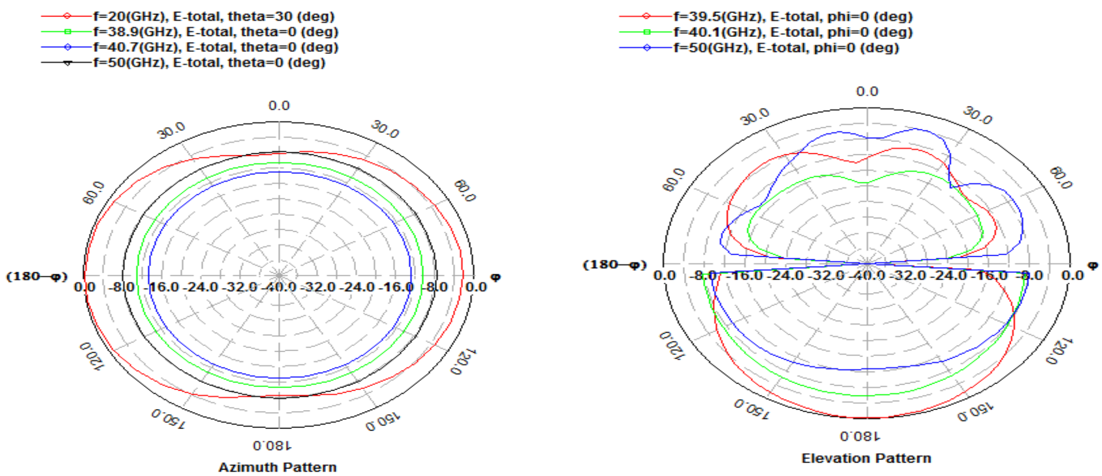


Fig 9 Simulated Results for azimuth and elevation pattern of the proposed antenna

The antenna radiation pattern in terms of azimuth and elevation angle is shown in Fig 9. Here the E plane and H plane radiation pattern for 8.2 GHz and 9.2Ghz is presented. The antenna is operated at the directive pattern. In the proposed antenna, we can further improve the directivity by using some additional reflectors either exciting the patch or ground plane.

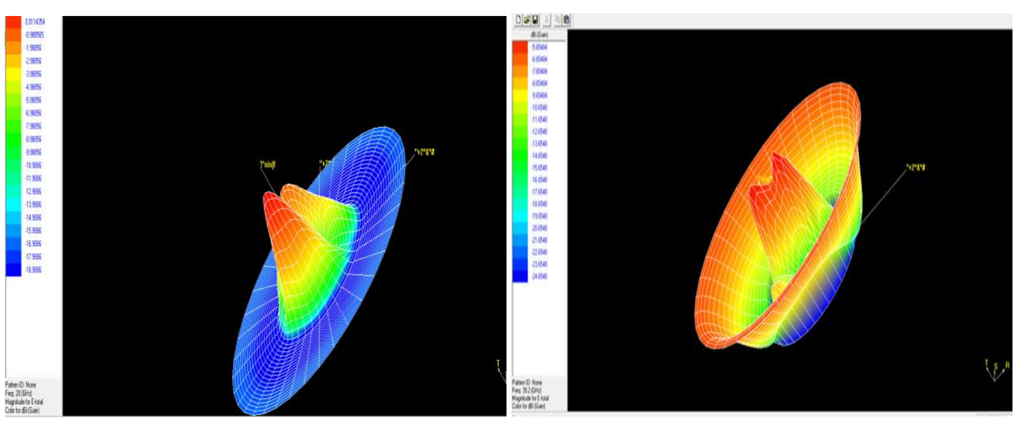


Fig 10 3D view of Radiation Pattern of an antenna

The 3D radiation pattern for 8 and 9.2 GHz is shown in Fig.10 the radiation pattern along with the gain And the polarization is as clearly presented by using this 3D radiation pattern. From fig, it is clear that the radiation pattern is stable throughout the entire band.

IV Conclusion

In this article, the wide band terahertz on-chip antenna for terahertz frequency applications, style is novel and compact for linear polarization, and also the antenna is appropriate for twenty nine to fifty one gigacycle per second frequency. The antenna is suitable for 5G application and quick change in terms of semiconductor devices. The planned antennas reportable during this design are compared with alternative THz antennas and results show the advance in terms of an antenna parameter will be a possible candidate for recent THz applications, reminiscent of spectroscopy, sensing, medical diagnosis, and high rate wireless hotspots.

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