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Original research article

THz rectangular microstrip patch antenna employing polyimide substrate for video rate imaging and homeland defence applications

Amarveer Singh Dhillon [a], Divesh Mittal [b], Ekambir Sidhu [c,*]

[a] *Department of Engineering and Applied Science, University of Regina, Canada*
[b] *Department of Civil Engineering, Punjabi University, Patiala, India*
[c] *Department of Electronics and Communication Engineering, Punjabi University, Patiala, India*

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ABSTRACT

This paper demonstrates a polyimide based optical rectangular patch antenna capable of operating at THz frequencies. The proposed antenna's performance has been analysed in terms of various antenna characteristics such as impedance bandwidth (GHz), directivity (dBi), gain (dB), return loss (dB) and VSWR. The Polyimide substrate having thickness of 20 μm and lower dielectric constant, ε_r of 3.5 has been employed in the antenna design. The feedline, radiating patch and ground deployed in the proposed THz antenna design are of copper (Cu) having conductivity and resistivity of 5.8×10^7 S/m and 1.68×10^{-8} Ω– m, respectively. The proposed antenna has been fed by means of microstrip feedline having impedance of 49.78 Ω. The proffered antenna has a gain of 5.22 dB and directivity of 5.08 dBi at corresponding resonant frequency of 0.67 THz. The propounded antenna has an impedance bandwidth of 40.16 GHz with operating frequency range of 0.65 THz to 0.69 THz with corresponding resonant frequency of 0.67 THz. The proposed antenna can be suitably employed for video rate imaging system (0.6 THz) and homeland defence applications (0.6–0.8 THz). The designing and simulation of the proposed antenna has been performed using CST Microwave Studio 2014 based on the method of FDTD technique.

1. Introduction

The growing demand of wireless applications has presented RF engineers with continuing call for low cost, power efficient, and small size system designs [1]. The basic communication establishing component of any wireless system is its antenna [2]. In potable wireless communication devices, the Microstrip antennas are widely employed because of their unique advantages of compact, conformal and low-cost features [3]. The Microstrip patch antennas due to their compactness and ease of fabrication are of particular interest for these systems [2]. The demand of ever increasing for efficient compact wireless systems requires innovative design with a high integration level of active components, circuitry and the radiating elements [4]. While the compact electronic circuit design is best achieved on high dielectric constant substrates and PCB, the optimum patch antennas are built on low-permittivity substrate for satisfactory performance [5]. However, the low bandwidth, low power handling capacity, low gain and low directivity are the major drawbacks of MPA [6].

* Corresponding author.
E-mail address: esidhu@pbi.ac.in (E. Sidhu).

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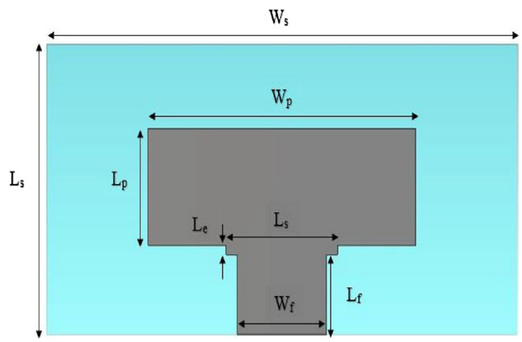

Fig. 1. Top View of the Proposed Antenna.

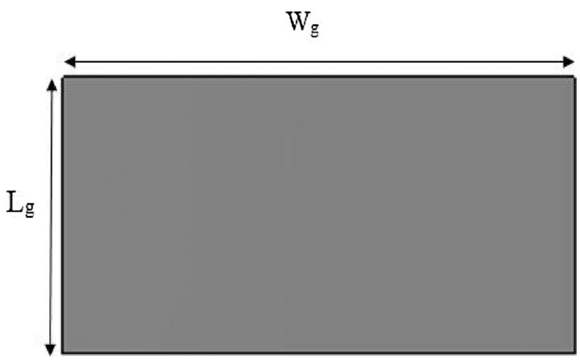

Fig. 2. Bottom View of the Proposed Antenna.

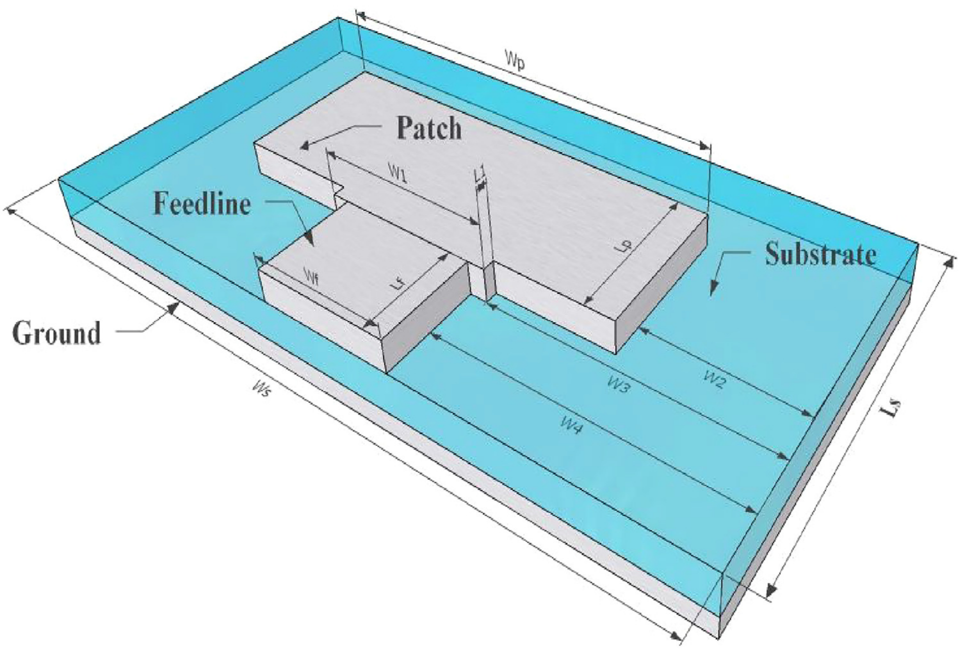

Fig. 3. 3-D view of the Proposed Antenna.

The frequencies higher than microwaves offer many advantages for wireless communication technology which includes broad-bandwidth for high data rate information transmission, improved spatial directivity and low probability of interference and system compactness as the antenna dimensions become extremely small at THz frequencies [7]. The Terahertz frequency (THz) band is coarsely defined as a portion of the electromagnetic spectrum, which extends from 0.1 THz to 10 THz and occupies an extremely large regime of electromagnetic spectrum between the infrared and microwave bands [8]. This