Circularly Polarized Dielectric Resonator Antenna for the Terahertz Band Applications

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***Abstract*—The design of a circularly polarized Dielectric Resonator Antenna (DRA) fed by an aperture coupled technique for THz applications is presented in this paper. The Dielectric Resonator Antenna has a bandwidth of 115 GHz (from 0.925 to 1.04 THz) due to a cross slot aperture and four symmetrically rotated slots in the ground plane. The achieved simulated gain and efficiency values are 8.08 dBi and 83%, respectively. It is proved that the proposed DRA provides an axial ratio (AR) bandwidth covering the whole operating band. Through a parametric study, we optimized the DRA's dimensions to achieve circular polarization and operate efficiently over a large frequency band.**

Keywords—Dielectric Resonator Antenna, terahertz THz, Circular polarization, aperture coupled technique.

I. Introduction

Terahertz (THz) communications use frequencies ranging from 300 GHz to 10 THz, with high spectrum resolution and large bandwidth tunability. Operating in the THz band has the potential to enable several applications such as biomedical imaging, security screening, and high-speed wireless data connections, among other things [1]. Dielectric resonator antennas (DRAs) [2] have recently received a lot of attention due to their compact volume, simple excitation, and adjustable bandwidth. Due to the absence of metallic losses, a high radiation efficiency can be achieved with DRAs.

In this paper, we propose a circularly polarized (CP) DRA, where the cross-slot aperture and four symmetrically rotated slots etched in the ground plane have been addressed, thus yielding to an improvement in the operating and axial ratio bandwidths. Our DRA design has been simulated using CST Microwave Studio. Obtained results demonstrate the high potential of the DRA due to its large THz frequency band, spanning between 0.925 and 1.04 THz, high gain of 8.08 dBi, and enhanced efficiency of 83%. Consequently, our antenna design is very suitable to THz-based applications.

II. Proposed Antenna Design

Fig. 1 shows the proposed single fed broadband circularly polarized DRA, which consists principally of a cylindrical DRA, zigzag-shape strip for feeding, and a perfect electric conductor (PEC) etched ground plane placed just above a silicon substrate of relative permittivity ε_r=11.9, with the antenna's optimal dimensions provided. Moreover, DRA has a relative permittivity ε_r=6.0. An extra axial ratio passband can be induced by truncating a cylinder of radius *R_in* and four orthogonally positioned arms with the same length *L_slot* and width *W_slot* from the DRA, resulting in a wideband CP-radiation.

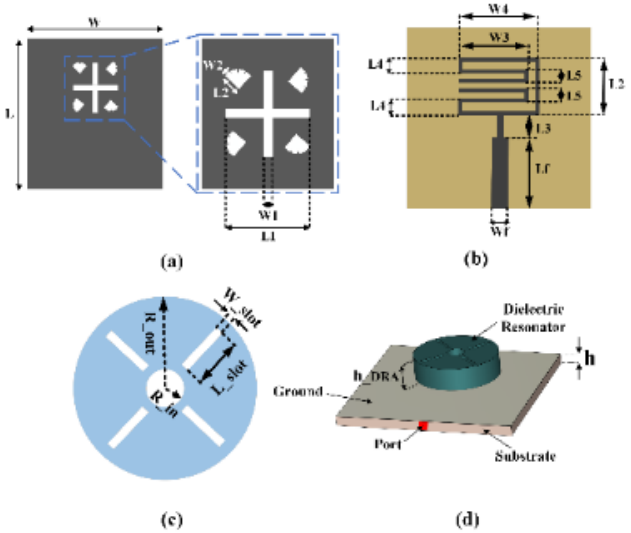

Fig. 1. Geometry of the proposed antenna: (a) Ground (b) Feeding network (c) Dielectric resonator cross-section (d) antenna 3D view.

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