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Rectangular Shaped Antenna with Deposition of CDS Nano Crystalline Material

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Abstract: ***A new rectangular shaped antenna is presented and studied in this paper. This antenna is having Teflon substrate with deposition of CdS material and overall size of proposed antenna is 15 × 32 mm^2. Dielectric constant of Teflon substrate is 2.1 and synthesized CdS material having permittivity of 8.9. CdS nano crystalline film was synthesized by Chemical Bath Deposition (CBD) technique at 70^{0}C for 2 hours and also studied its structural, optical and morphological properties beyond all this properties CdS material is showing radiating property which is performed by CSTMWS^4 software. Obtained result of impedance bandwidth is ranges from 11.236 to 20.249, radiation pattern is Omni-directional and has a simulated gain values up to 8.9 dB, and the total efficiency of antenna is 99%. The results are showing acceptable performance in terms of return loss, radiation pattern, realized gain, etc.***

Keywords: Teflon, CdS, permittivity, radiation pattern, return loss

I. INTRODUCTION

Recently, antenna technology has been employed in a wide range of applications such as radar, telemetry, navigation, biomedical system, mobile satellite communications, the direct broadcast system, GPS, and remote sensing. For these systems designing an appropriate antenna is a most important challenging task. While the Micro strip patch antenna grabbing the attention of researchers all around the world, Micro strip antennas are generally made of copper or gold and may be of any shape, but convention shape is used to simplify the mathematical analysis. Conformal wrap wound antenna can be fabricated with the help of flexible substrate.

It is low fabrication cost, light weight, low volume and can fabricate easily. [1] Cadmium sulphide is a chemical compound that has the formula CdS. It is yellow in color and is a semiconductor of electricits. It exists as two different polymorphs, hexagonal greenockite and cubic hawlelite. The synthesized group II-IV semiconductor in a nano powder form has been rapidly growing area of research due to their excellent optical, physical and chemical properties. [2] This CdS thin film has experienced a fast rising mainly due to its applications in piezoelectric transducers, laser materials and photovoltaic cells, also it can be used as a window material together with several semiconductors such as CdTe, Cu2S and CuInSe2. [3] Teflon is the registered trade name of the highly useful plastic material polytetrafluroethylene.

With the help of Teflon or PTFE material, 60GHz frequency patch antenna was designed or use in a millimeter- wave wireless communication system. [4] the idea for this design of antenna comes from the paper which is presented by Kenny Seungwoo Ryu et.al in 2010 [5] and reference of this paper dipali soren et.al presented a new designed antenna mounted on vertical ground plane edge. [6] CdS material gives optical, morphological, structural and other different properties with different substrates which was reviewed in paper [7] and also studied properties of CdS material with Teflon substrate.[8]

In our paper in optimize design from the resonance characteristics it has been observed we observed the impedance band width is extend from 11.326 GHz to 20.249 GHz. which shows the broad side radiation pattern. In the remainder of the paper Section 2 deals with antenna design with strip feed arrangement and parametric study. This is followed by resonance and radiation characteristics in Section 3 with final concluding remarks in last.

A. Antenna Configuration

The geometry of proposed antenna is illustrated in Fig1. Total dimensions of antenna are 32 × 15 mm^2 and rectangular shaped antenna substrate (Teflon) having dielectric constant of 2.1 and thickness is 2.3 deposition of CdS material which is having permittivity of 8.9 and the thickness of 0.22 mm on both side, excited by the microstrip feed line. TABLE I showing the dimensions of proposed antenna.

TABLE I Antenna Dimension

Parameters	Dimensions	Parameters	Dimensions
W_S	16 mm	W_2	2 mm
A	15.4 mm	g	1 mm
L_S	22 mm	L_G	10 mm
D	21.2 mm	L_{STRIP}	9.3mm
L_1	5.2 mm	W_{STRIP}	1 mm.
L_P	6mm	t	0.22

The feeding position placed in the middle surface of substrate. The parameters for the antenna is W_S = width of substrate, L_S =length of substrate, a= width of deposited CdS material, d= length of CdS deposited material, W_{STRIP} =width of strip1, L_{STRIP} = Length of strip1, L_S= Length of strip2, W_S=Width of strip2, g= gap between ground plane and deposited CdS material, L_G = Length of ground plane, t= thickness of deposited CdS material as shown in fig.1

II. PARAMETRIC STUDY

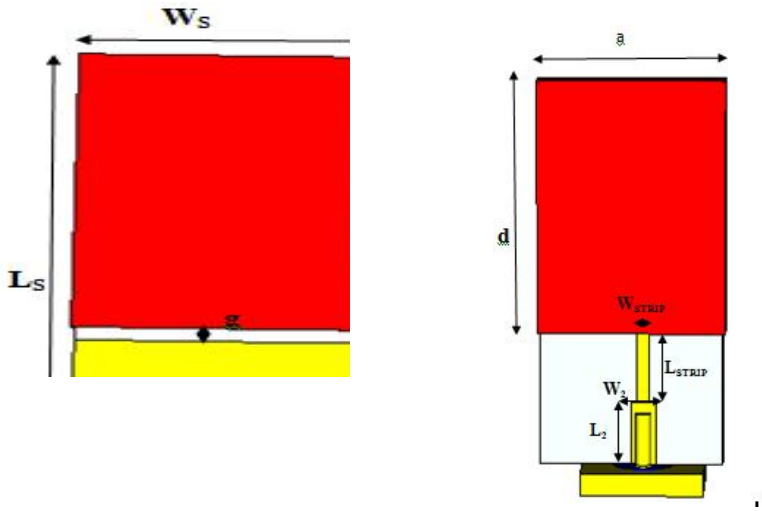

Fig1 Geometry of proposed antenna (a) front (b) back

Rectangular shaped antenna and is designed and simulated and found that it gives the operating frequency of 11.254GHz to 20.349GHz which is suitable for mobile and satellite application. The performance of proposed antenna varies when the position of micro strip feed line is changes.

Fig2 shows that the parametric study of different position of micro strip feed line as we can see that feed line is left, right and corner position and in corner position we obtained larger bandwidth.

Fig3 shows the parametric study for the different permittivity of substrate (copper, glass, zinc and Teflon) which are 5,8, 1.7 and 2.1.and Teflon material is showing excellent radiating property.

Fig4 shows the simulated return loss for different ground length for L_G= -6 mm then the impedance bandwidth is maximum.

Fig5 presenting the parametric study of thickness of deposited CdS material and t=1 gives the best result. Fig6 shows the reflection coefficient for different pin length, L_P= -11.7 along y axis or 6mm length give suitable bandwidth. Fig7 introduced the parametric study of different strip length, L_{STRIP}=-1.5mm along y axis or total 9.3mm length then only this bandwidth is prominent.

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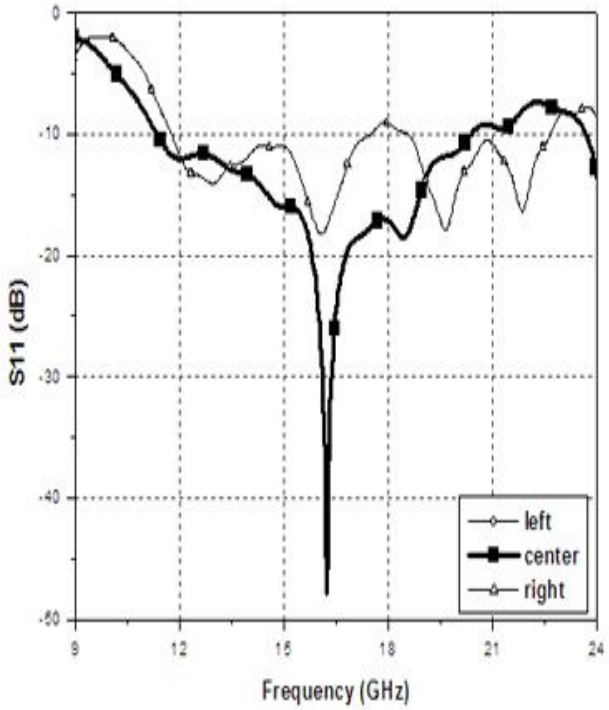


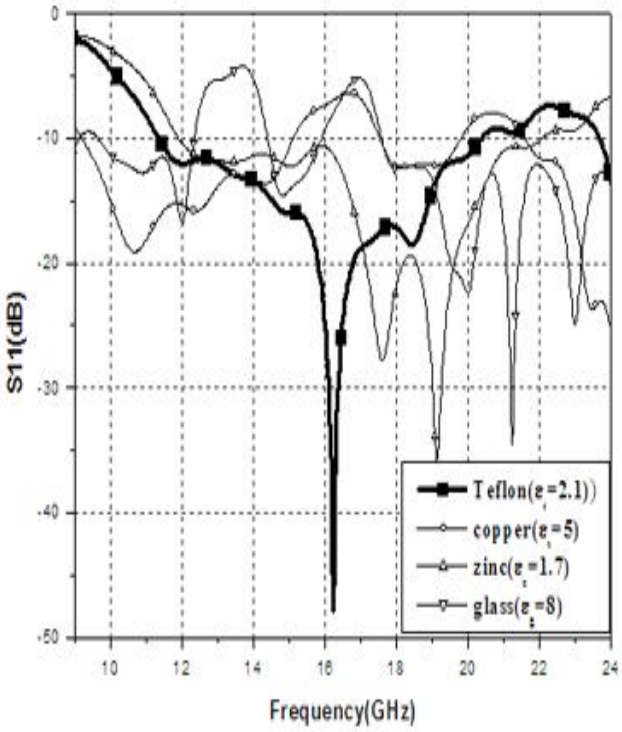
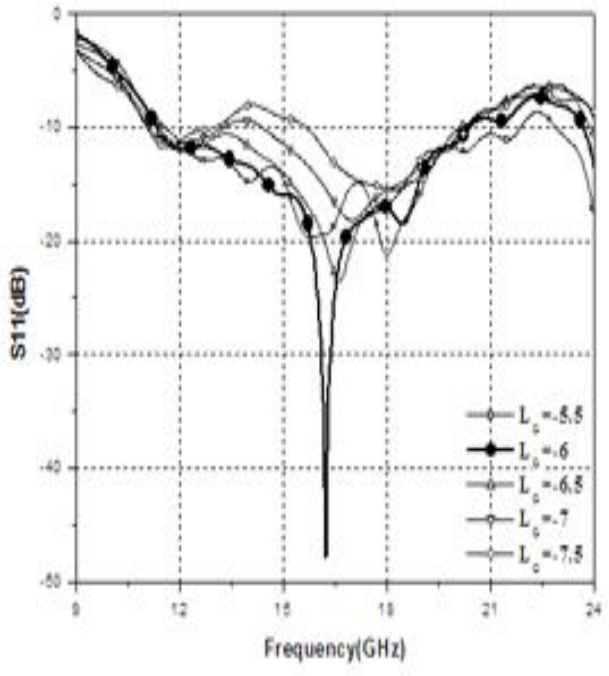


Fig2 Simulated reflection coefficient for different positions of microstrip feed lines in antenna
Fig3 Comparison of return loss plot of Teflon, copper, zinc and glass substrate respectively mounted on a vertical ground plane edge with strip feed



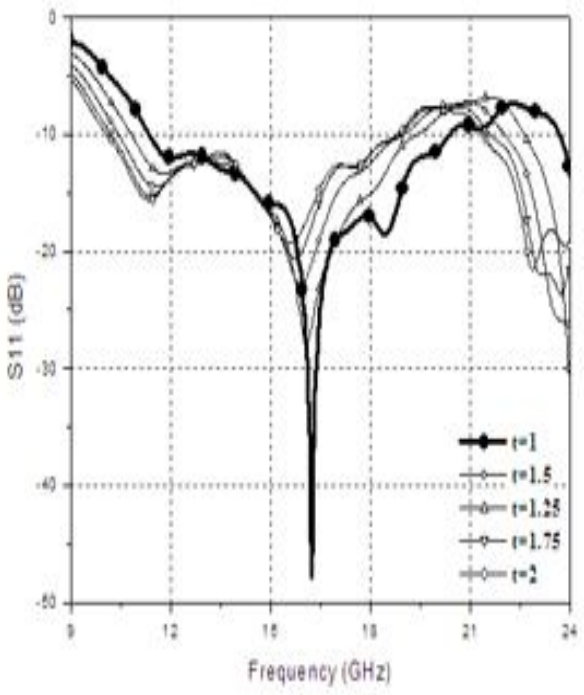


Fig 4 Variation in S11 curves after varying length of ground
Fig 5 Variation in S11 curves after varying length of ground plane

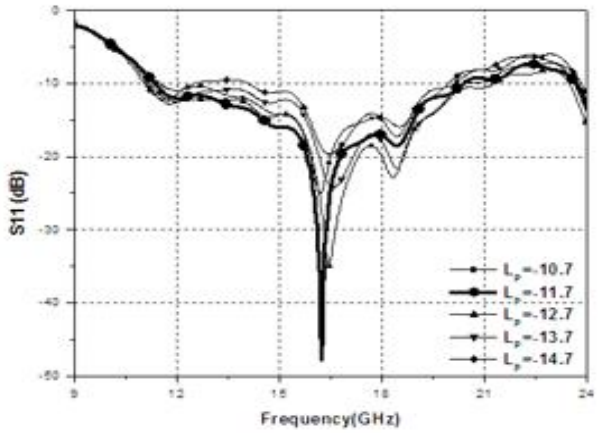


Fig 6 Variation in S11curves after varying length of Strip1

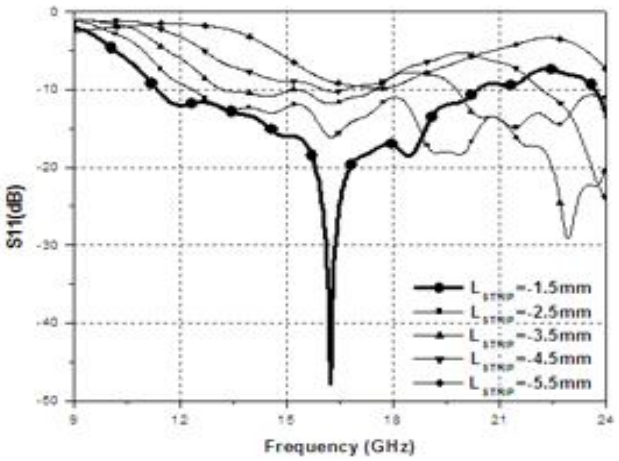


Fig 7 Variation in S11 curves after varying length of Strip1

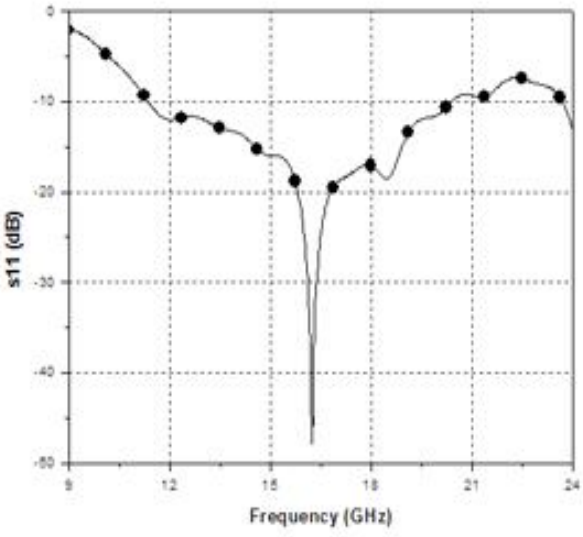


Fig8 Return loss plot of typical rectangular design antenna with deposition of CdS material on teflon substrate mounted on a vertical ground plane with strip feed.

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III. RESULTS AND DISCUSSION

As the final result, the best permittivity of substrate is 2.1 is observed and at the center side strip found the best position of microstrip feed line. We also observe that without deposition of CdS material it was radiated but after deposition of material it showed larger bandwidth for antenna. From this result, it is obvious that the proposed antenna provides a wide impedance bandwidth from 11.254 to 20.349 GHz. Fig.9 shows the reflection coefficient of final proposed antenna and The designed antenna have total efficiency is 99% and the gain is approximately 9.6 dB. Fig9 shows the gain v/s frequency plot of proposed Antenna. Fig.10 and fig.11 shows the normalized simulated far field patterns at phi=90^0 and phi=0^0 respectively which covers larger bandwidth. As can be observed, these radiation patterns are giving the Omni-directional results which are showing good agreement.

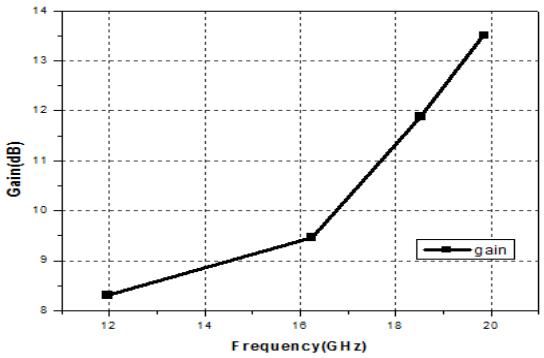

Fig9 Gain v/s frequency plot of proposed antenna.

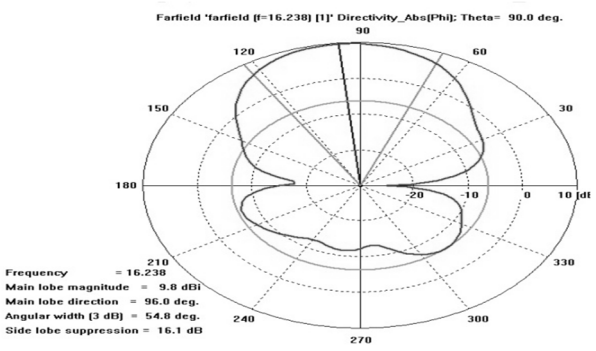

Fig 10 Far-field radiation pattern of proposed antenna at phi=90^0

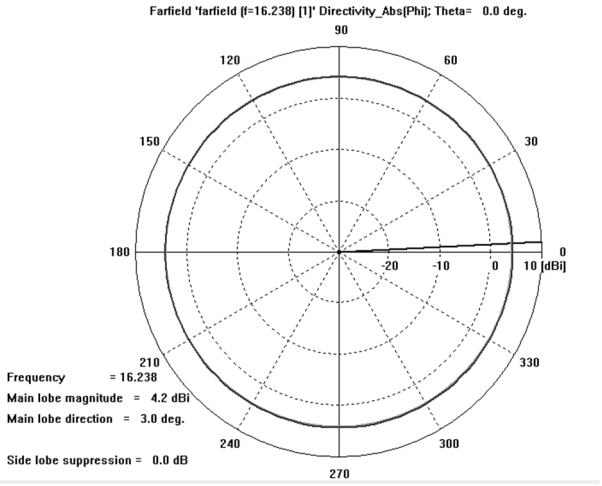

Fig 11 Far-field radiation pattern of proposed antenna at phi=0^0

IV. CONCLUSION

In this paper, a rectangular shaped CdS deposited Antenna is presented. The proposed antenna is shows the 99% total efficiency with 9.6 dB gain over the 11.254 to 20.349GHz frequency interval which covers almost 60% impedance bandwidth. The Radiation pattern is observed Omni-directional. The antenna is small in size which is of 32 × 15 mm^2 and giving the application of wireless communication system.

V. ACKNOWLEDGEMENT

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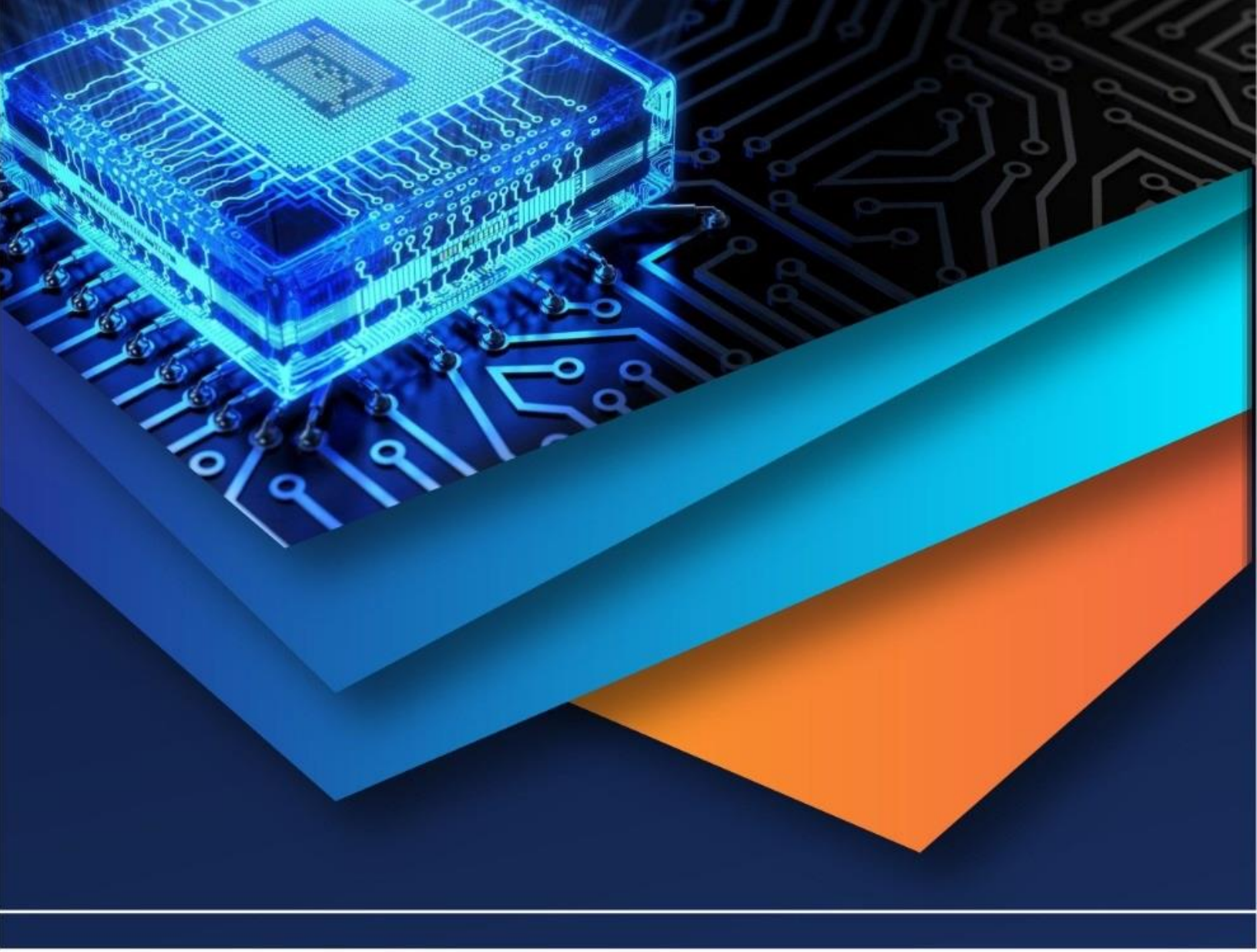

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