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A Review Paper On Graphene Based DRA

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Abstract- *This paper represents a study of a Graphene based Dielectric Resonator Antenna (DRA) Antenna. In recent years Dielectric Resonator antenna has been playing a key role for wireless service requirements. Many structures of DRA have been applied to certain areas as it offers various benefits such as no inherent conductor loss, simpler coupling and the advantage of being lightweight. In this project we will be dealing with a conical shaped DRA with a coating of graphene and a micro strip technique to gain its enhanced features in different applications of ultra wide band.*

Keywords: *Dielectric Resonator Antenna (DRA), Graphene, Microstrip feeding, application*

I.INTRODUCTION

Antenna is always a powerful and supreme part of wireless communication system. Over the past few decades the design of DRA has caught many researches attention because of its high h RE, Low loss, easy to excite and wide IBW compare with microstrip antenna. Moreover, using the dielectric constant (ε_r) of the DRA material, size and bandwidth can be easily control to achieve high gain and high radiation efficiency. A dielectric resonator antenna (DRA) is a radio antenna mostly used at microwave frequencies and higher. It consists of a block of ceramic material that can be of various shapes, the dielectric resonator which is mounted on a metal surface and also a ground plane. DRAs rely on radiating resonators that can transform guided waves into unguided waves (RF signals) CurrentlyDRAs that are made from plastic material (PolyVinyl Chloride (PVC)) are used. Some of the main advantages of DRAs are:

(ii)DRAs can be characterized by a large impedance bandwidth if the dimensions of the resonator and the material dielectric constant are chosen properly.
(iii)It can be excited by using different techniques for array integration.
(iv)We can control the gain, bandwidth, and polarization characteristics of a DRA.
Graphene is a single layer of carbon atoms, tightly bound in a honeycomb lattice. It has a very unique 2D structure and basically,the horizontal dimension can be extended whereas thickness remains in atomic scale. When we put this material in a 3d structure, it starts exhibiting a very high specific surface area and a low density. Also, graphene has many electrical powers - one of them being its good carrier mobility. Its band structure is also good enough for it to be used in radio frequency circuits. The reason we chose graphene for our project was because graphene in itself has a very unique structure wherein the movement of electrons happen with less resistance. This makes it a better suitable option than metal which can become lossy at high frequencies. A microstrip is a metallic patch placed on dielectric substrate supported by grounded plane. It is easily miniaturized and integrated with microwave devices making it a popular choice of transmission line.

(i)Compare to the metallic traditional form of antennas that we see usually, DRAs are characterized by a smaller form factor
A microstrip antenna (also known as a printed antenna) usually means an antenna fabricated using photolithographic techniques. It was invented by

"Robert E Munson". After, the invention of IC's microstrip came into use. Microstrip Patch Antennais as shown in Figure 1.

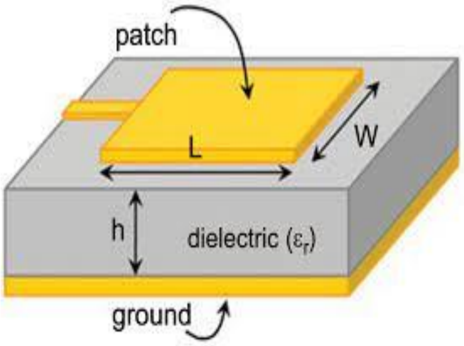
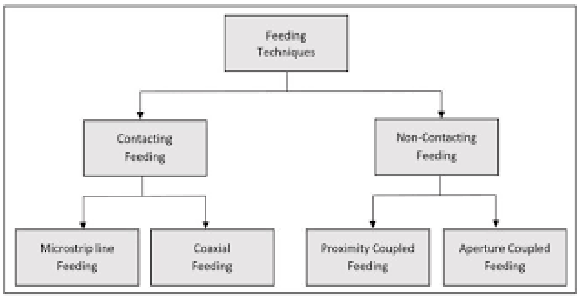


Fig 1: Microstrip Patch Antenna

FEEDING TECHNIQUES

Feeding techniques are classified in two categories. The one is contacting and the other is non-contacting. There are four types of the feeding techniques and they are coaxial probe, microstrip line, aperture coupled and proximity coupled.



(A) Contacting Feeding

1. Coaxial Probe Feed

In this feeding method, the inner conductor of the coaxial connector extends through the dielectric and is soldered to the radiating patch, while the outer conductor is connected to the ground plane. This, type of feeding is easy to match, fabricate, and have low spurious radiation due to which efficiency becomes good. The coaxial probe feed is as shown in Figure 2.

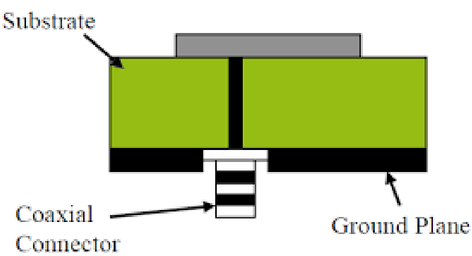


Fig. 2: Coaxial Probe Feed

2. Microstrip Line Feed

It is a feeding technique, in which the microstrip patch is directly connected with the conducting microstrip feed line. It is easy to match, fabricate and model. To overcome the problem of varying impedance we notch and do feeding to reduce the reflection losses.

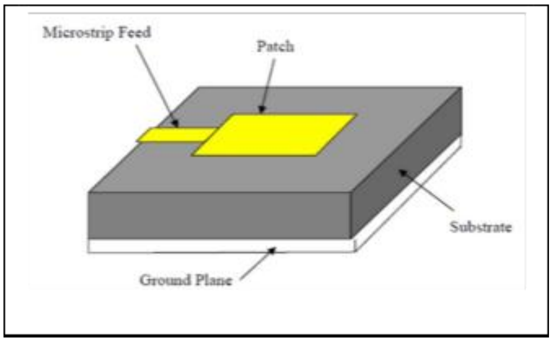


Fig. 3: Microstrip Line Fee

(B) Non-Contacting Feeding

1. Aperture Coupled Feed

In this type of feeding there are two substrates, which are different from each other and are separated by a ground plane and the microstrip patch and feed line are coupled through a slot in the ground plane. It is easy to model and have low spurious radiation. The aperture coupled feed is as shown in Figure 4.

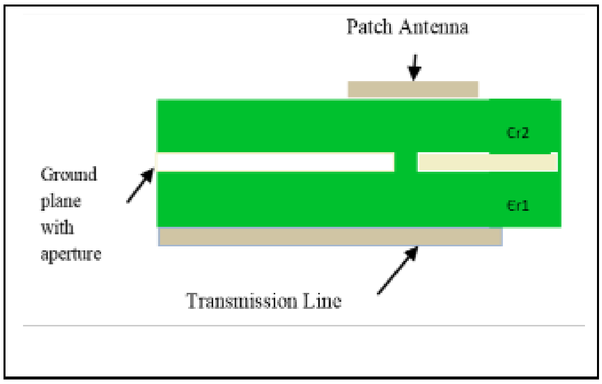


Fig. 4: Aperture Coupled Feed

2. Proximity Coupled Feed

In this feeding method two dielectric substrates are used in this technique. The microstrip patch is there at the upper surface of the upper dielectric substrate and the feed line is there between two substrates. It provides highest bandwidth, easy to model and avoids spurious radiation due to which efficiency is good. The proximity coupled feed is as shown in Figure 5.

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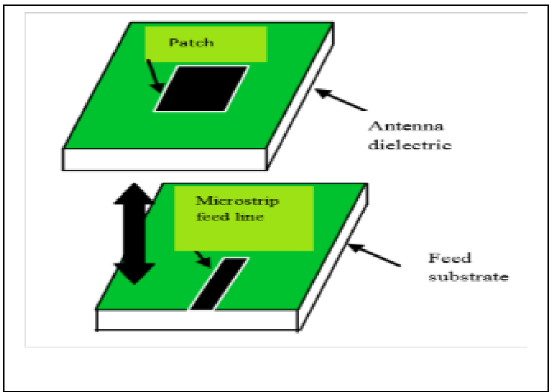

Fig. 5: Proximity coupled Feed

II. LITERATURE REVIEW

In (6) this paper, A rectangular low-density, high-permittivity dielectric resonator antenna (DRA) excited by T-shaped microstrip feed offering a2:1 VSWR bandwidth of 22% at 2.975 GHz is reported. The excellent gain and radiation performance of the proposed antenna projects it as a potential candidate for telecommunication applications.

In (7) this paper, Dielectric resonator antennas (DRAs) designed for broadband applications and excited by L-shaped probe are presented. The performance of this DRA and those fed by traditional probes and slots are investigated numerically. In addition, comparisons between L-probe excited DRAs and L-probe excited microstrip patch antennas are discussed

In (8) this paper, a new dielectric resonator antenna (DRA) is introduced for ultra wideband applications. A rectangular dielectric resonator, a bevel feeding patch and an air gap between the DR and ground plane are used to obtain an ultra wideband impedance bandwidth.

In (9) this paper, Simple wideband rectangular dielectric resonator antenna (DRA) for the X-band and Ku-band applications is presented. The DRA is excited by a vertical strip through a coaxial probe attached to a finite size ground plane. Good agreement between measured and simulated results is obtained.

In (10) this paper a novel portable dielectric resonator antenna (DRA) design with broadside radiation is presented for ultra wideband wireless applications and narrow pulse sensor for breast cancer detections. A modified version of the rectangular dielectric resonator antennas also considered. Comparison between the two antennas is presented with parametric study.

In (11) this paper Detailed study of the effect of various parameters variation of the conical DR along with the circular slot provided for aperture coupling in ground plane is notified and simulated.

III. ANTENNA PARAMETERS

Different parameter such as VSWR, Return Loss, Antenna Gain, Directivity, Antenna Efficiency and Bandwidth is analyzed.

(a)Gain: Gain of an antenna is defined as the ratio of intensity, in a given direction to the radiation intensity that would be obtained if power accepted by antenna were radiated isotropically.

$$G=\frac{4\pi . U(\theta,\emptyset)}{P_{in}}$$

Where, U (θ, Φ) is an intensity in a given direction, Pin is input power

(b) Antenna efficiency: It is a ratio of total power radiated by an antenna to the input power of an antenna.

$$\boldsymbol{e_o = e_r e_c e_d}$$

Where, e_o = total efficiency e_r = reflection efficiency e_c= conduction efficiency, e_d= dielectric efficiency.

(c)VSWR: It is the ratio of the maximum voltage to the minimum voltage.

$$VSWR=\frac{V_{max}}{V_{min}}$$

(d)Radiation Pattern:A mathematical function or a graphical representation of radiation properties of the antenna as a function of space coordinates.

(e)Return Loss: It is the difference in dB between the forward and reflected power.

$$\text{Return loss} = 20log_{10}\left(\frac{VSWR+1}{VSWR-1}\right)$$

III. APPLICATIONS

1. For detecting cancerous cell in the human body
2. UV tracking patch
3. For 5G applications
4. Gas detector and air sniffers
5. Cryo-cooler compressor for 5G

IV. CONCLUSION

This paper presents the review on past work done in the field of dielectric resonator antenna. After carefully, studying these research papers and different experimentations done on DRA, we can see that by choosing proper techniques, modifying feed geometry structure of DRA we can easily increase the bandwidth. The variation of different physical parameters of the antenna which affect the working region and operation of the antenna were studied.

With every new research there was an attempt to make a progress in this field. While reading these, we saw that a DRA with a metal coating faces many disadvantages which we believe can be eradicated by coating it with graphene. There seems to be a need for nano-antennas needed for upcoming technology and graphene is the best option for that.

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