CHAPTER: 9

DRA OVERVIEW AND WORKING

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Ch.Id:-ASU/GRF/EB/RPETHEAT/2022/Ch-09
DOI: https://doi.org/10.52458/9789391842888.2022.eb.grf.asu.ch-09

Richtmeyer shown non-metalized dielectric objects similar like metallic cavity in DRA in 1939.After various research in 1960 DRAs used for RF filters, oscillators at microwave frequency applications. In 1980 sager suggested DR with enhance the radiation resistance of electrically short probes and loops .The high permittivity DRs aim to Structured experimental investigations on dielectric resonator antennas were first carried out by Long et al in 1983. An antenna with ceramics material operating in microwave frequency with dielectric permittivity $\varepsilon_r \geq 10$ is known as dielectric resonator antenna. This DRA describes three fundamental like hemispherical, cylindrical and rectangular.

DRA Working Principle

The DRAs radiate as a magnetic dipole and the process of radiation initiates from the reflection of input EM waves thereby leading to the formation of standing waves. On removal of conducting metallic walls the EM energy radiates into the free space. The outer edges of the DRA act as magnetic wall from which the magnetic fields leak out as a result of fringing. This leads to the effective radiation and the absence of these peripheral conducting walls the conductor losses in the DRA become negligible.

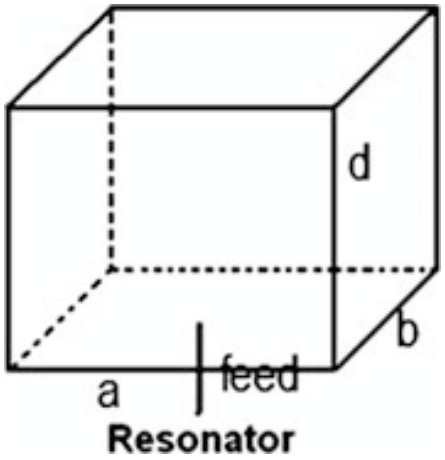

Figure 9.1: Rectangular dielectric ring resonator

The Hemispherical DRA

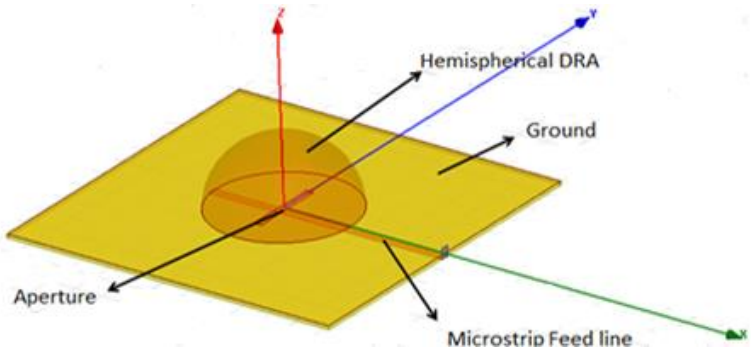

Figure 9.2: Hemisphere DRA

This DRA is composed with permittivity ε_r and radius a units. The DRA can be mounted directly on the conducting ground and excite using aperture coupling mechanism .DRA needs to be erected on conductor ground plane backed by substrate of lower permittivity. In hemispherical DRA assumed that the ground plane possesses infinite conductivity and is extended till infinity. The radiation modes of DR can be broadly classified in to transverse electric (TE) and transverse magnetic (TM) modes for antenna . When the radial component of electric field E_r becomes zero a TE mode is generated, similarly for radial magnetic field H_r reducing to zero a TM mode is propagated. In a typical hemispherical DRA, TE_{111} mode is identified as the lowest order or dominant mode.

Cylindrical DRA Insight

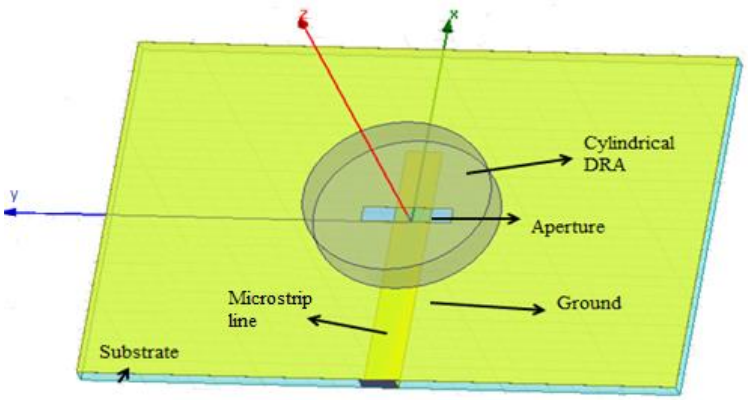

Figure 9.2: cylindrical DRA

DRA provides the antenna additional flexibility in form of aspect ratio *a/h* and dielectric constant ε_r, where '*a*' and '*h*' denote the radius and height of the DRA respectively. Aspect ratio of the cylindrical DRA which determines the values of Q-factor and $k_o a$ at any given dielectric constant. This enables the antenna designer to create a tall slender DRA operating at the same resonant frequency as that of a wide base but thin DRA. However, the Q-factor shall be different in these two cases. This feature of cylindrical DRA provides an extra edge over hemi spherical DRAs.

The Rectangular DRA-

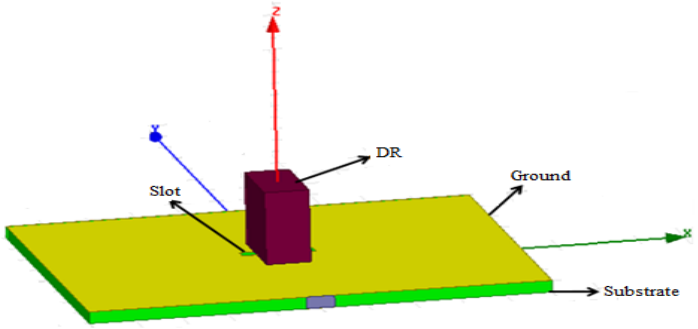

Figure 9.3: Rectangular DRA

Rectangular DRA consists of three dimensions length *d*, width *w* and height *h* as depicted in Figure (9.3). The RDRA provides an extra degree of freedom as compared to cylindrical DRA and hemisphere DRA thereby becoming the most versatile of all the DRA shapes. It provides enhanced flexibility to antenna designers by selecting the ratios *w/h* and *w/d* independently in order to attain the required bandwidth and profile. The four walls of RDRA perpendicular to *xy*-plane are supposed to be a case of perfect magnetic walls in the direction of a propagating wave.

CONCLUSION

This chapter explains the principle and structure of DRAs which can be effectively used along with curve fitting method to design DRAs with much accuracy. DRAs various technologies and recent researches has been presented in lucid manner to provide an outlook of DRAs.