

HIGH GAIN CONICAL CUP MICROSTRIP ANTENNAS

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Abstract

In this paper, a new conical cup microstrip antennas is presented. This new antenna improves a antenna gain and narrows beamwidths in both planes to be compared with a general circular patch antenna (without the cup). The gain of this antenna is about 12.7 dBi.

1. Introduction

Microstrip patch antennas may be useful as either a primary feed single antenna or primary feed array element antennas of a paraboloidal reflector antenna for on-board satellites because of its light weight and planar geometry. A single patch antenna is to reduce a spill-over efficiency since its beamwidths are generally pretty wider than an optimum 10 dB beamwidth of a parabola reflector. To achieve a narrow beamwidth and a moderate gain of a single patch antenna some researches have been carried out [1,2,3]. A microstrip patch antenna surrounded by a metallic cylinder has shown promising results [1]. In this paper, we present the effect of a metallic conical cup on a single circular patch antenna with experimental and simulation results.

2. A high gain conical cup microstrip antenna design and experiments

Fig. 1 shows the configuration of the cup microstrip antenna which is surrounded by a cylindrical cavity with a top open [1]. The thickness of the metallic cup is 0.2 mm ($\lambda/10$).

This circular patch is printed on Arlon's PTFE substrate. It has a relative permittivity of 2.17 and a substrate thickness 1.524 mm. The microstrip antenna has a probe fed circular patch with a diameter of 46 mm (0.38λ), but it is linearly polarized. The diameter of the substrate is about 1 λ (120 mm). Its operating frequency is 2.5 GHz. Fig. 2 shows the configuration of the new conical cup antenna. The other conditions are the same as the cup microstrip antenna as shown Fig. 1.

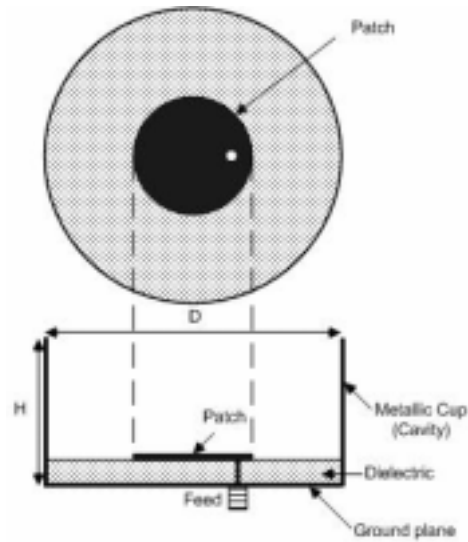


Fig. 1 Configuration of the cup microstrip antenna.

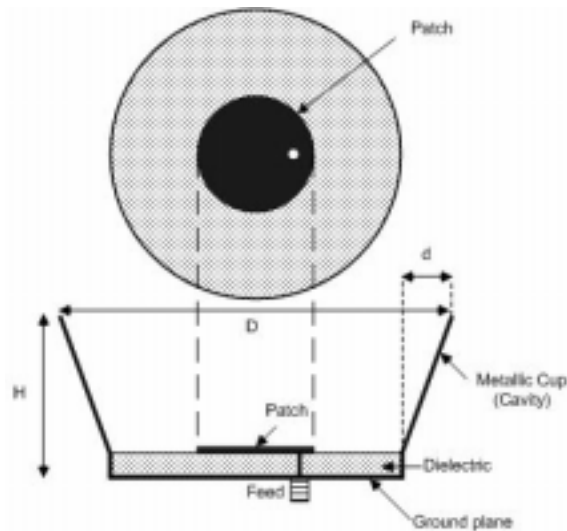


Fig. 2 Configuration of the new conical cup antenna.

3. Results

The gain of the cup microstrip antenna against the height of the cup is shown in Fig. 3. The computed gain is about 1~3 dBi higher than the measured ones and both are increased as the height of the cup rises until the gain peaks. The gain is the highest when the height of the cup is $1/3$ (40 mm). Fig. 4 shows the gain of antenna against the diameter of the cup when the height of the cup is fixed at $1/3$ (40 mm). The simulated result in Fig. 3 shows the maximum gain of the cup microstrip antenna at $1/3$ (40 mm). From this result, it is suggested that a conical cup has the height of $1/3$ (40 mm). To investigate the effect of a cone shape on the antenna gain, the distance between the axis and the circumference has been examined. Fig. 5 shows that the gain of the new conical

cup microstrip antenna with a $1/3$ height against the distance d . In this case the gain is the maximum when d is 30 mm ($1/4$). Fig. 6 shows that 3 dB beamwidths (H-plane and E-plane) against d . These beamwidths are getting narrow monotonically as d is increased. The antenna gain increases as the beamwidths are getting narrow due to the effect of the conical cone, while the gain decreases after passing the gain peak as the side lobe level increases.

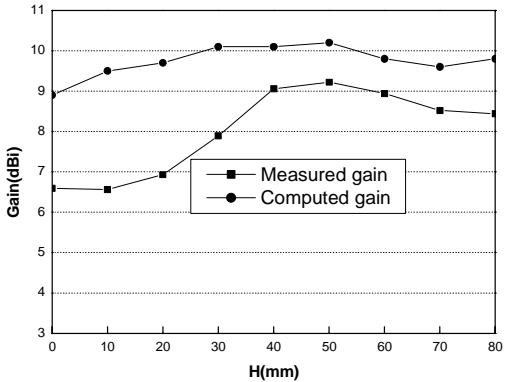


Fig. 3 Gain against the height of the cup.

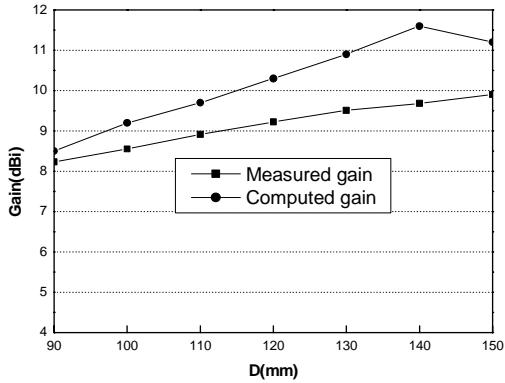


Fig. 4 Gain against the diameter of the cup.

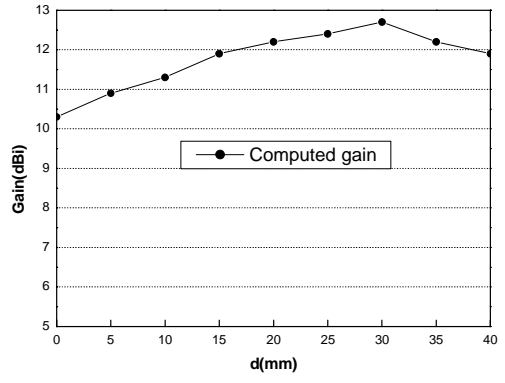


Fig. 5 Gain against the distance d of the conical cup antenna.

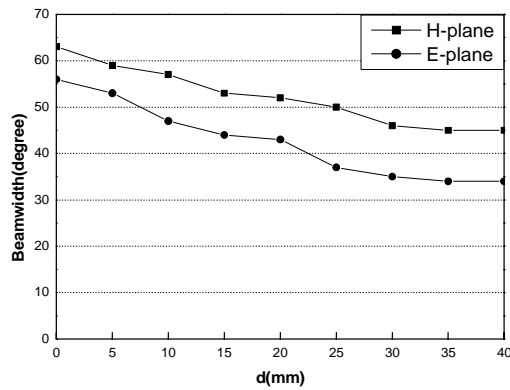


Fig. 6 Computed beamwidth against the distance d of the conical cup antenna.

The radiation patterns of the new conical cup microstrip antenna is shown in Fig. 7 when d is 30 mm ($1/4$) and the height is 40 mm ($1/3$).

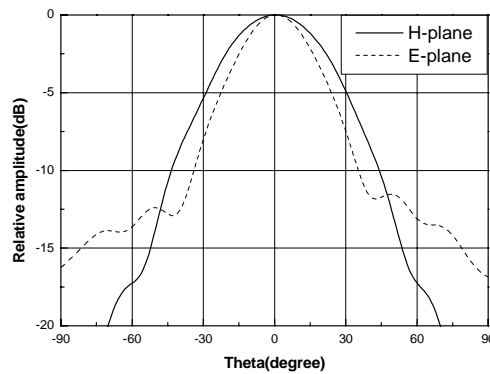


Fig. 7 Computed radiation patterns of the conical cup antenna.

4. Conclusion

The new conical cup antenna is yielded that the antenna gain is increased and it narrows the beamwidth as the height of the conical cup is increased and d is expanded. The optimum results are obtained that the gain is the maximum when the height of the conical cup is $1/3$ (40 mm) and d is $1/4$ (30 mm). The above computed results will be verified by experiments in the near future.

References

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