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# Microstrip Patch Antenna resonating at 5.8 GHz by using Plasmonics

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## Abstract

In this paper, we made an attempt to make a simple antenna resonating at 5.8 GHz with good return loss, gain and VSWR. By the help of metal grating, gain, VSWR, Return Loss, have been improved as compared to conventional antenna resonating at 5.8 GHz. We have obtained Return Loss of -30.981 dB and gain of 7.925 dB. Because an antenna acts as interface for wireless tool, so we need to make an efficient antenna. The proposed antenna can be used for Wi-Fi. CST Microwave Studio simulation tool is used for simulation.

## I. Introduction

In recent times, microstrip patch antenna has been used in a number of applications. It is used for Wi-Fi, WI-Max and in various communication purposes. Microstrip patch antenna is considered as one of the most dynamic field in communication. It is also easy to understand and design because of its simple geometry and it is relatively inexpensive to manufacture. Moreover, microstrip patch antenna is a low profile, light weight antenna. It supports linear and circular polarization. So, it finds application in numerous places. Despite of all these advantages, there are some limitations. Microstrip antenna has less gain and bandwidth. So, designing an antenna of good gain and bandwidth is a task. Plasmonics antenna is obtained by using metal grating which has dimensions less than the operating wavelength. This metal grating guides the microwave. Many parameters like resonant frequency, return loss, gain etc changes on varying height, thickness and position of the metal grating. Feeding mechanism is the way we input radio waves into the antenna structure. The feeding can be contacting or non- contacting. It's based on connectivity of radio frequency power supply with the antenna. Coaxial cable and microstrip line are contacting feeding technique. Aperture feeding and proximity are non contacting feeding type. For our 5.8 GHz antenna we have used microstrip line for feeding and the metal grating is unsymmetrical.

When the width of slit of the grating is much smaller as Compared to the operating wavelength, the wave does not travel through the slit because it is limited by diffraction limit [1, 2].

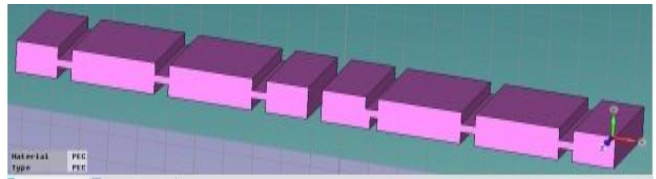

Figure 1 Unsymmetrical metal grating

The geometric dimensions and shapes of the structured metal control the dispersion properties of surface Plasmon [2].

The shape and the geometric dimension can be varied in order to achieve desired gain, resonant frequency, return loss and other parameters.

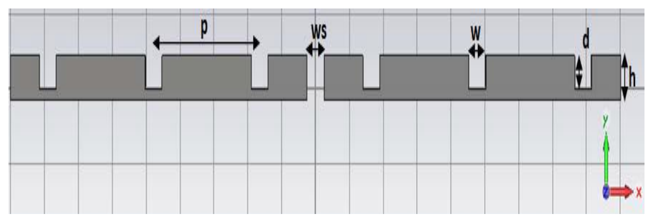


Figure 2 Unsymmetrical metal grating

TABLE.1

| Metal height | Grating depth | Grating period | Grating width | Slit width |
|---|---|---|---|---|
| h | d | P | w | $w_s$ |

In case of symmetric metal grating (refer to Fig.1), the incident wave penetrates for the same slit width ($w_s$). It bounds the wave into dimensions which are much smaller than the operating wavelength.

The coherent delocalized electron oscillations which lie at the interface between a metal and a dielectric are called surface plasmons. [2]

In 2004, it has been proposed Pendry et al. that surface plasmon can be simulated by the addition of sub-wavelength array of holes on the structure of metal [1, 2].

## II. Antenna Design

The proposed microstrip patch antenna resonates at 5.8 GHz. Microstrip line feeding is used. The RF power to rectangular patches may be supplied from radiating or the non-radiating edge. To get impedance matching along the non-radiating edge we can use the Transmission Line Model. The design parameters of the antenna are given in Table. 2

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**TABLE. 2**

| | |
|---|---|
| Operating frequency | 5.8 GHz |
| Wavelength in free space | 51.724 mm |
| Height of substrate | 1.524 mm |
| Dielectric const. of substrate | 3.2 |
| Tangent delta el. | 0.0025 |
| Type of grating | Unsymmetrical |
| Thickness of grating | 30 mm |
| Position of grating (above the origin) | 15.5768 mm |
| Type of feeding | Microstrip line |

This antenna was obtained by application of metal grating, then its position was varied to get desired antenna..

The substrate used is a material of dielectric constant 3.2 and tangent delta el. = 0.0025. We have used unsymmetrical grating. The geometry proposed for the plasmonic based 5.8 GHz microstrip patch antenna is shown in fig 3.

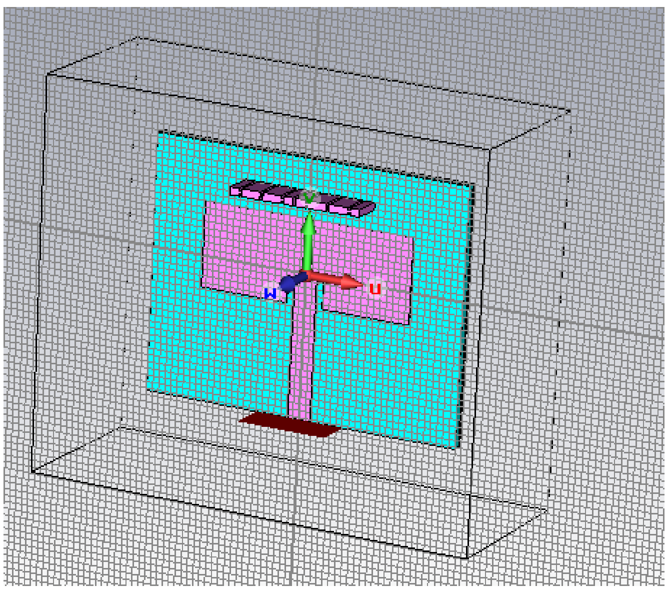


**Figure 3.** **Front view of simulated plasmonic based 5.8 GHz antenna**

## III. EXPERIMENTAL RESULTS

CST Microwave Studio is used for simulation. Antenna resonates at 5.8 GHz. Return loss of -30.981 dB and VSWR of 1.058 is obtained. Following figures are the Return loss plot and polar plots for different values of phi.

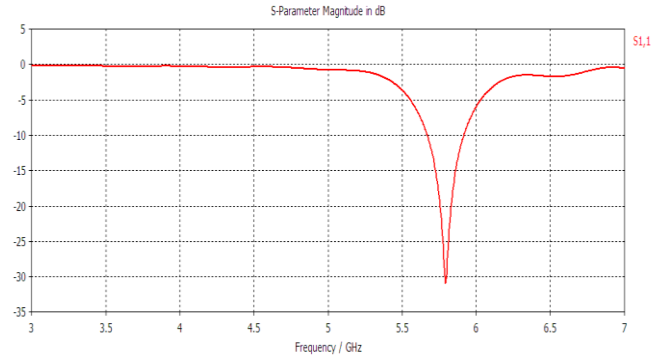


Figure 4 The Return loss plot of 5.8 GHz plasmonic based antenna

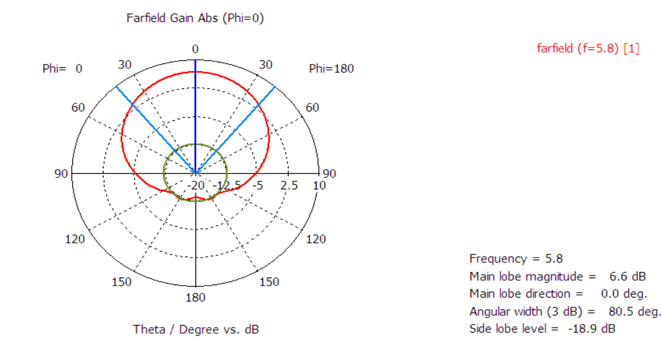


Figure 5. Polar plot for phi=0

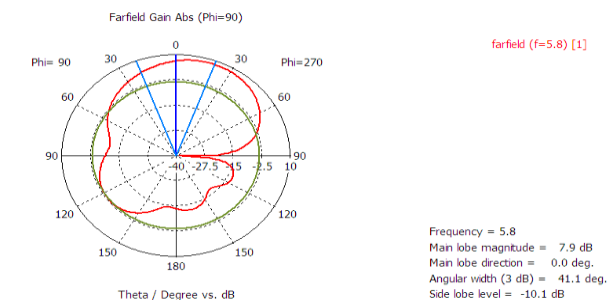


Figure 62.Polar plot for phi=90

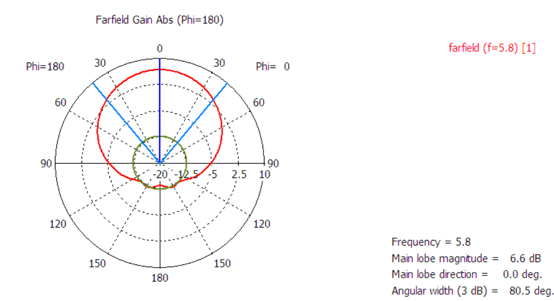


Figure 7 Polar plot for phi=180

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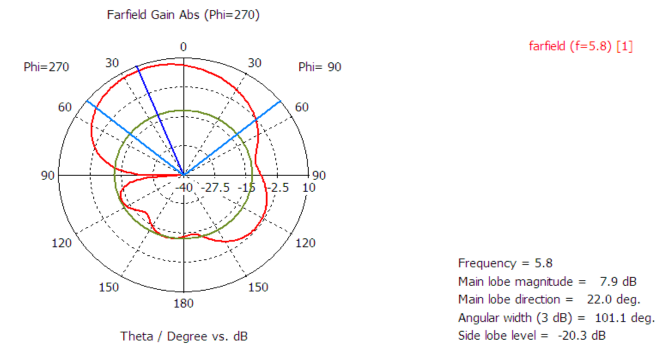


Figure 8 Polar plot for phi=270

From surface current distribution plot we can see that plasmonic metal grating helps in guiding and confining the microwave.

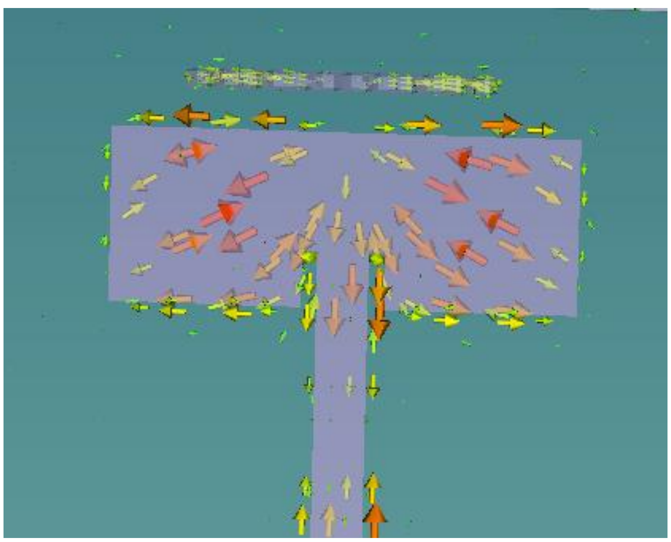

Figure 9 Distribution of surface current

TABLE.3

| Frequency | Return Loss | VSWR | Gain | Radiation efficiency |
|---|---|---|---|---|
| 5.8 GHz | -30.981 dB | 1.058 | 7.925 dB | -0.9157 dB |

## IV. EXPERIMENTAL RESULTS

Basic conventional antenna resonating at 5.8 GHz had a gain of 6.12 dB and Return Loss of -25 dB. So, from table.3 it can be concluded that plasmonic based antenna has improved results.

## V. CONCLUSION

After using metal grating of thickness 30 mm and substrate of 1.524 mm height, we have obtained antenna operating at 5.8 GHz antenna. Metal grating helps in confining and guiding the microwave. The proposed antenna can be used for Wi-Fi. Fabrication is the next tas

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