FABRICATION AND MEASUREMENT

FABRICATION

There are 3 fundamental steps to fabricate an antenna after simulation in the software. The steps are-

1) Lithography
2) Development
3) Etching

These are the basic steps for fabrication. But the whole process follows some other important steps which cannot be overlooked. Some machines are needed here. Most importantly, this process must be done in a laboratory which is enriched with the necessary instruments and precautions must be followed.

Step 1

The simulated design is printed black by using any drawing software. We have used "CorelDraw software". Here is a sample picture from our experiment-

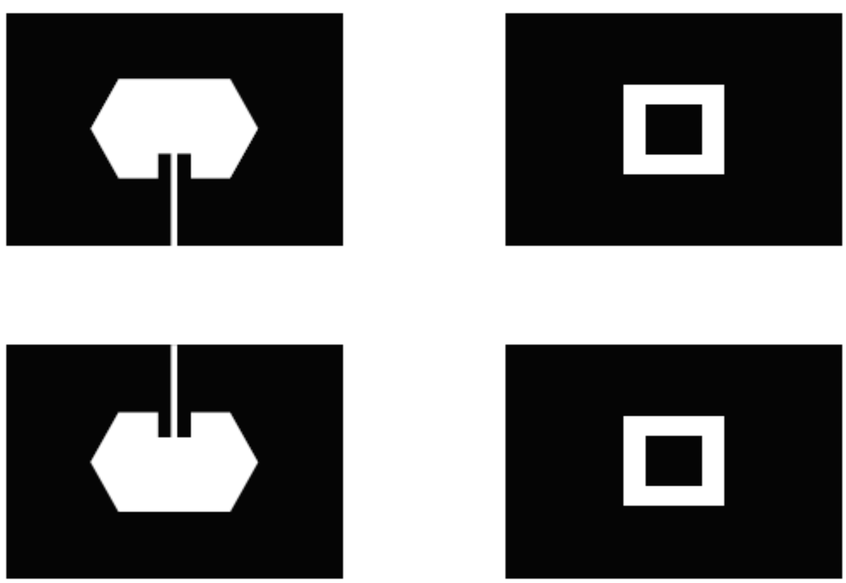

Fig 5.1: printed transparent paper in CorelDraw Software

The black footprint of the antenna is printed on a transparent paper and the dimensions are controlled. But here we have used the inverting method where the white part worked as mask.

Step 2

"The Laminator"- this should be pre-heated before using. Temperature should be in 105^0 Celsius. The blue paper is used here. Blue paper is also attached to previous step and the antenna is kept to the laminator to come from one side to the next side of the laminator. This process attaches the printed design to the substrate.

Fig 5.2: The Laminator

Step 3

The masked FR4 is inserted in the UV- LIGHT Exposure (the proper surface should face the light). This process should be continued for 2 mins approximately. And the temperature of UV is in 125^0 to 130^0 Celsius. The white part of the film will act as shielding mask during photo-exposure process. The area that is masked will maintain its photoresist properties and eventually will protect the copper from etching. Sometimes, if time exceeds more than 2 minutes, the laminating blue paper remains attached strictly to the antenna and it is very difficult to remove that paper.

The transparent film from previous step is cut down as rectangular shape as well as the substrate. We have taken FR4 substrate here. Carefully the transparent paper should be attached on the one side of the substrate. If the design is at both sides, then this process should be done twice.
The Step 3 and step 4 is known as lithography.

Fig 5.3: UV-Exposures before inserting antenna

Fig 5.4: UV-Exposures while working

Step 4

Now from previous step after attaching the printed design to the blue paper attached FR-4 substrate we need to mask it with Na_2Co_3mixture. It helps to remove the layer of blue paper from the copper portion. But before drowning it to the Na_2Co_3 mixture we need to make sure the plastic layer of printed design attached substrate should be removed. This plastic layer is a part of the blue paper.

Step 5

Now “Etching Machine” is needed. The etching machine should be heated for approx. 20 mins. Temperature is needed from 30^0 to 47^0 Celsius. A chemical (FeC_{12}) Ferric chloride is needed here to continue etching the antenna. There are two sections in this machine. In one part, antenna is washed out with ferric chloride mixture and the other section leaks water for washing the chemical from the antenna. This process continues approximately 1-1.5 minutes.

Fig 5.5: The etching machine

Step 6

To remove the laminating paper, NaOH (50gm) is used. The antenna is kept in this solution for 2 or 3 minutes and gradually the paper will be separated from the antenna. We can use our hand wearing gloves or use a hard stick to remove the paper. With this process, the fabrication is done, and the antenna gets ready practically.

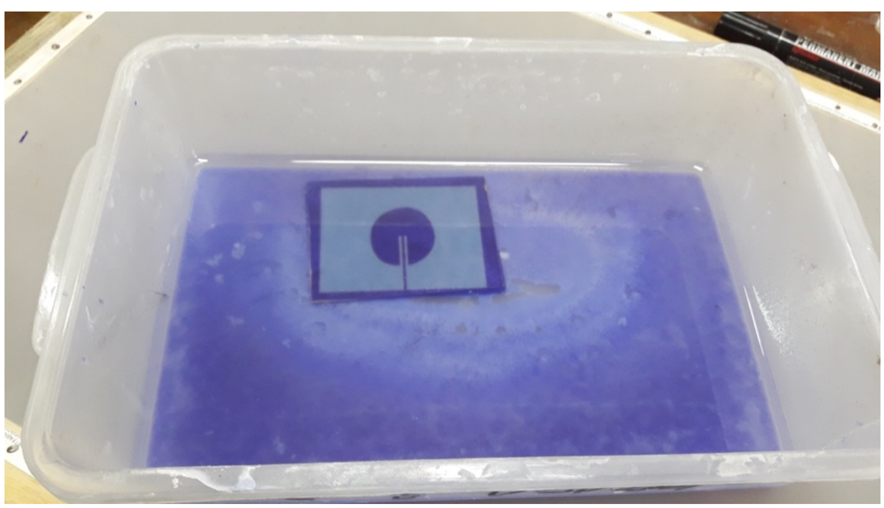

Fig 5.6: NaOH solution (working with circular shaped antenna)

Microstrip Patch Antenna (MPA) for circular shape

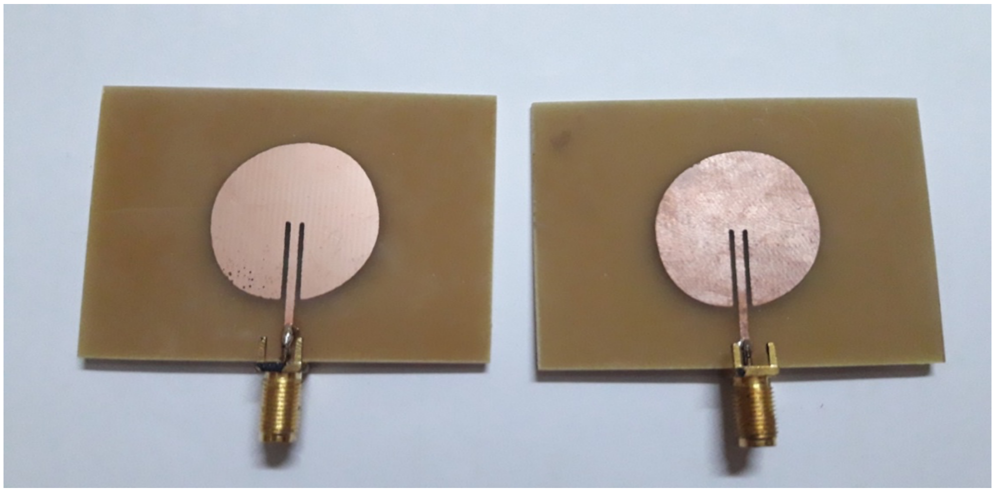

Fig 5.7: Circular shaped microstrip patch antenna after fabrication

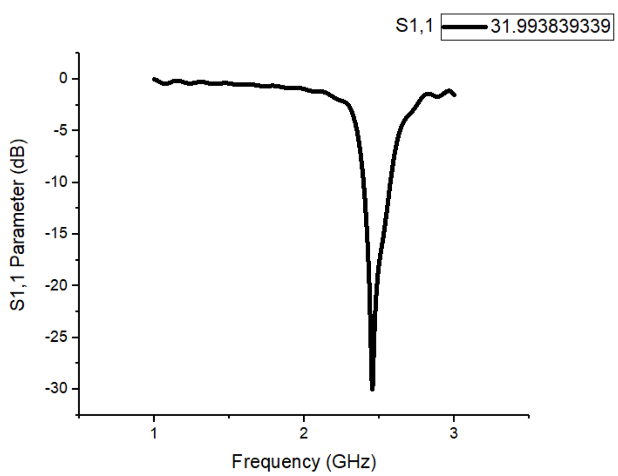

Fig 5.8: S1,1 parameter for circular shaped after the measurement

Table 5.1: Comparison between simulation and measurement results at the resonant frequency for circular shape

Properties	Simulation	Measurement
S1,1 parameter	-53.08	-31.99
VSWR	1.004	1.125

Microstrip Patch Antenna (MPA) for F shape

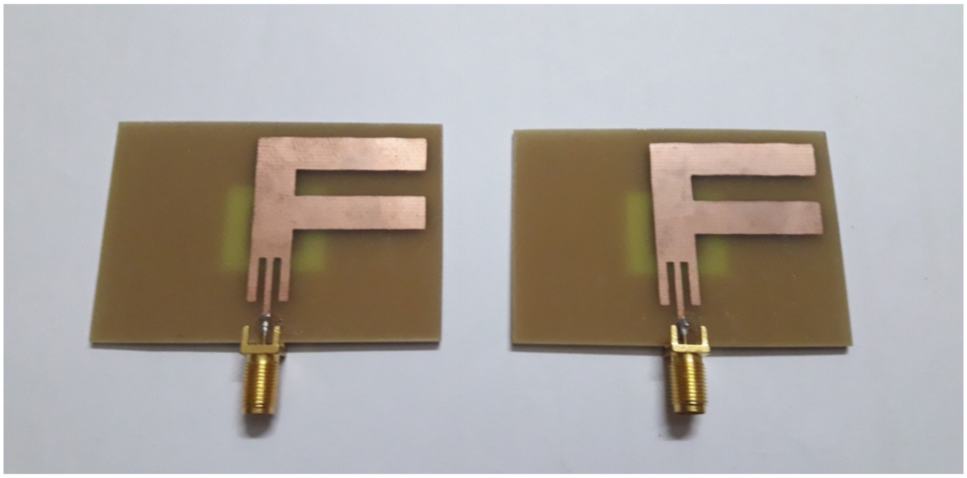

Fig 5.9: F Shaped microstrip patch antenna after fabrication

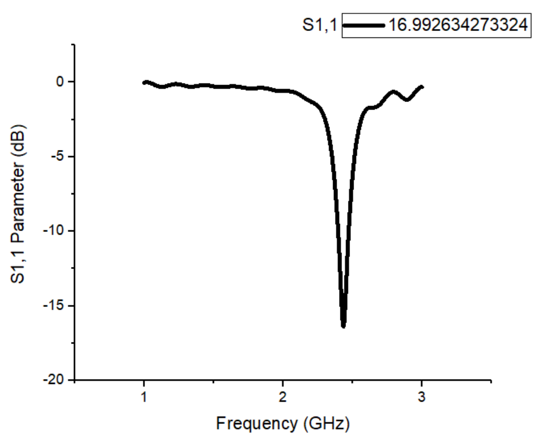

Fig 5.10: S1,1 parameter for F shaped after the measurement

Table 5.2: Comparison between simulation and measurement results at the resonant frequency for F shape

Properties	Simulation	Measurement
S1,1 parameter	-30.02	-16.98
VSWR	1.065	1.167

Microstrip Patch Antenna (MPA) for triangle shape

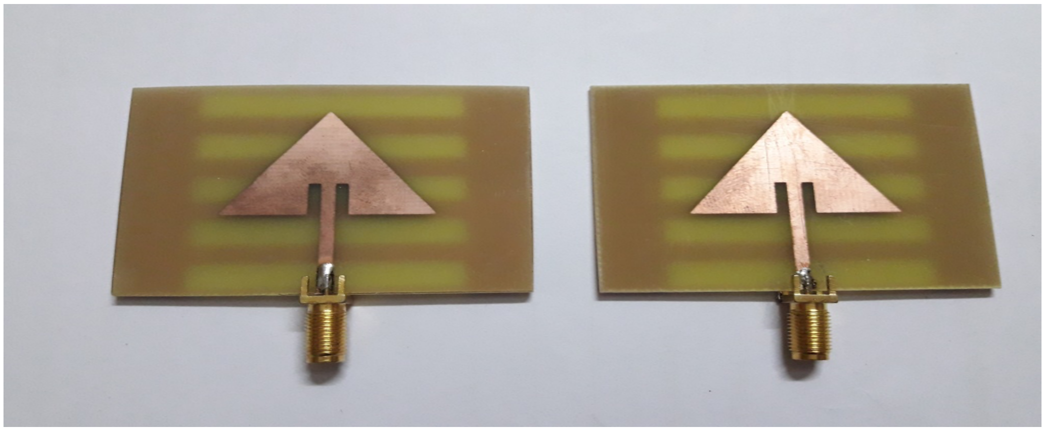

Fig 5.11: Triangular shaped microstrip patch antenna after fabrication

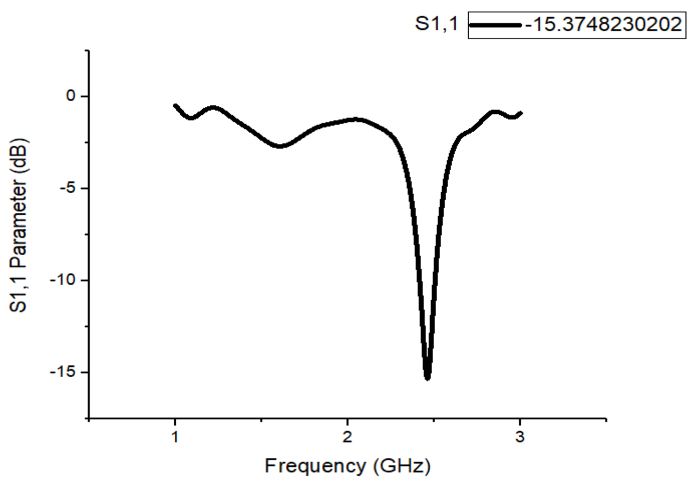

Fig 5.12: S1,1 parameter for triangular shaped after the measurement

Table 5.3: Comparison between simulation and measurement results at the resonant frequency for triangle shape

Properties	Simulation	Measurement
S1,1 parameter	-18.86	-15.37
VSWR	1.257	1.368

Microstrip Patch Antenna (MPA) for square shape

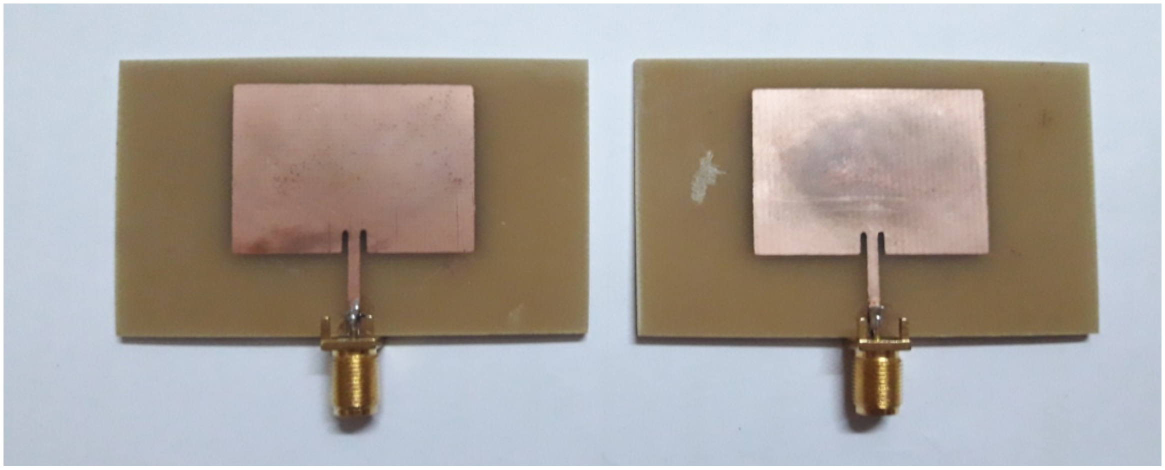

Fig 5.13: Square shaped microstrip patch antenna after fabrication

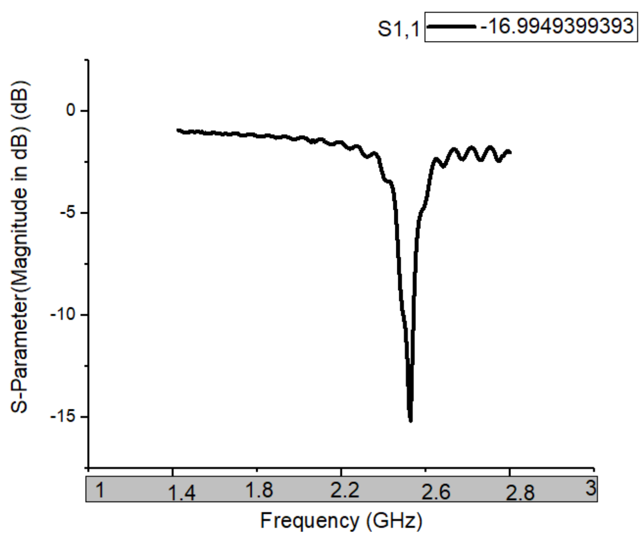

Fig 5.14: S1,1 parameter for square shaped after the measurement

Table 5.4: Comparison between simulation and measurement results at the resonant frequency for square shape

Properties	Simulation	Measurement
S1,1 parameter	-16.38	-14.46
VSWR	1.357	1.536

Microstrip Patch Antenna (MPA) for hexagonal shape

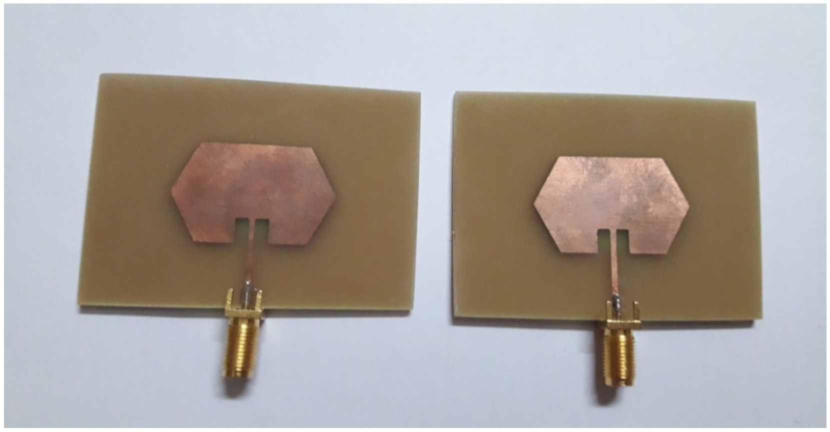

Fig 5.15: Hexagonal shaped microstrip patch antenna after fabrication

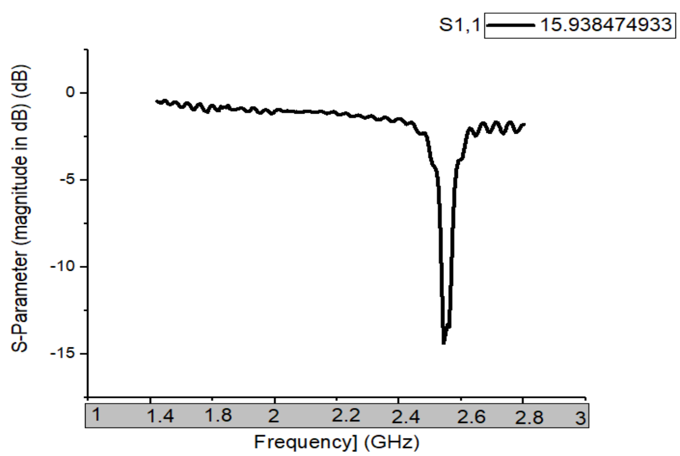

Fig 5.16: S1,1 parameter for hexagonal shaped after the measurement

Table 5.5: Comparison between simulation and measurement results at the resonant frequency for hexagonal shape

Properties	Simulation	Measurement
S1,1 parameter	-14.78	-13.93
VSWR	1.446	1.694