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In-House Copper Plated and 3D-Printed Antennas. A Low Cost and Rapid Iteration Process

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1. Radiation Group Overview
2. In-House Manufacturing Processes
 - 3D-Printing
 - Copper Plating
3. Manufactured Devices
 - Waveguides
 - Horn Antennas
 - Dielectric Loadings and Lenses
 - Spiral Antennas
 - Metastructures
4. Conclusions

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1. Radiation Group Overview

2 Full Professors:

Prof. Manuel Sierra Castañer
Prof. Ramón Martínez

5 Associate Professors:

Prof. Belén Galocha Iragüen
Prof. J.M. Fernández González
Dr. Miguel Salas Natera
Dr. Pablo Sánchez Olivares
Dr. José Luis Masa Campos

1 Assistant Professor

Dr. Adrián Tamayo Domínguez



3 Emeritus Professors:

Prof. Miguel Calvo Ramón
Prof. José Luis Besada Sanmartín
Prof. Manuel Sierra Pérez

10 PhD Students

10 Master thesis students
16 Degree thesis students

2 Laboratory engineers
2 Laboratory technicians
1 Administrative



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1. Radiation Group Overview. Collaborations

Very active collaboration with public and private institutions

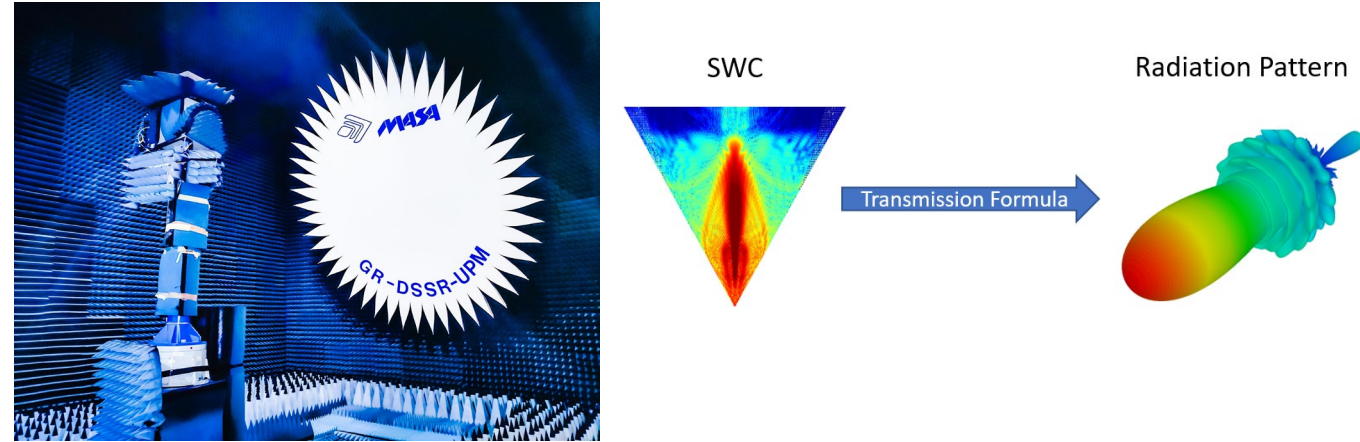


- Antenna Measurement Activities:**

- R&D and Systems Design.

- External Measurements through LEHA-UPM.

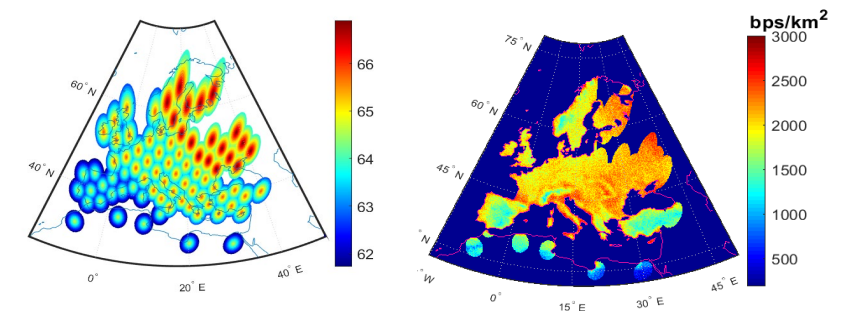
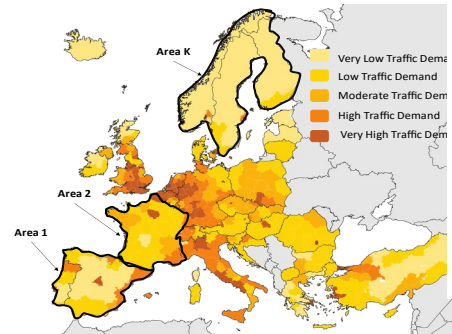
- Spherical, cylindrical, planar and compact range systems.



- Communication systems:**

- Smart Antennas and MIMO systems.

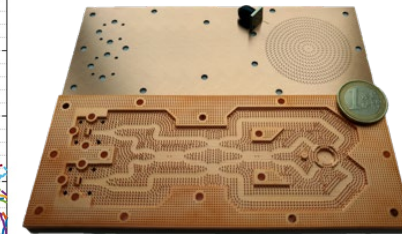
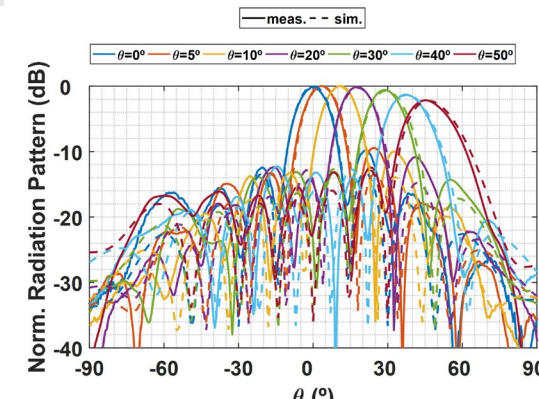
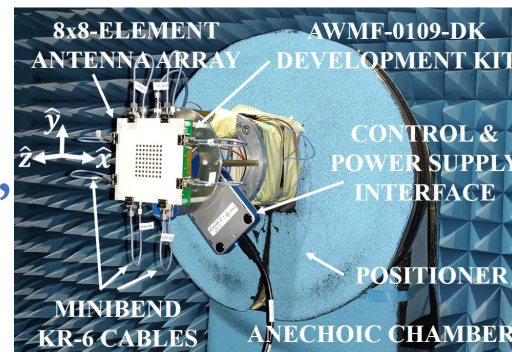
- Satellite communications systems.



- Antenna design and prototyping of different technologies:**

- Wire and planar antennas, horn antennas, arrays and reflectors.

- Manufacturing facilities for RF devices: Teralab.



RX (17.7-20.2 GHz), TX (27.5 – 30 GHz).

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2. In-House Manufacturing Process

3D-printing for mmWave

Metal (Cu, Al, Ti alloys, DMSL)

Plastic (resins, SLA)

Electroplating (optional)

Electroplating

Finishing (optional)

Finishing (optional)



Surface finish



Low weight



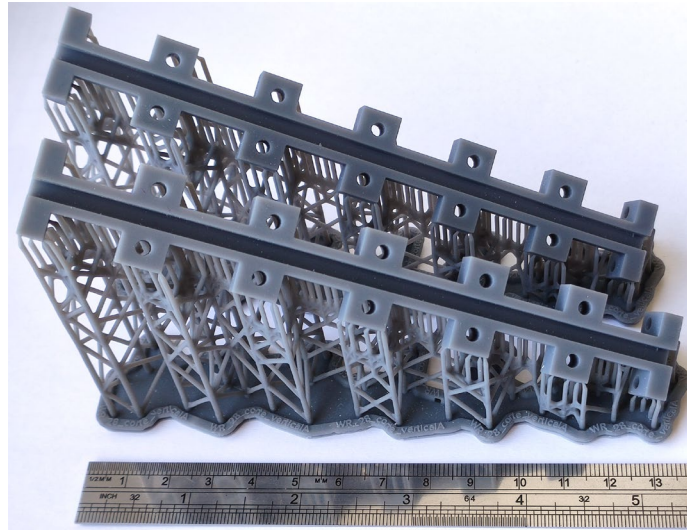
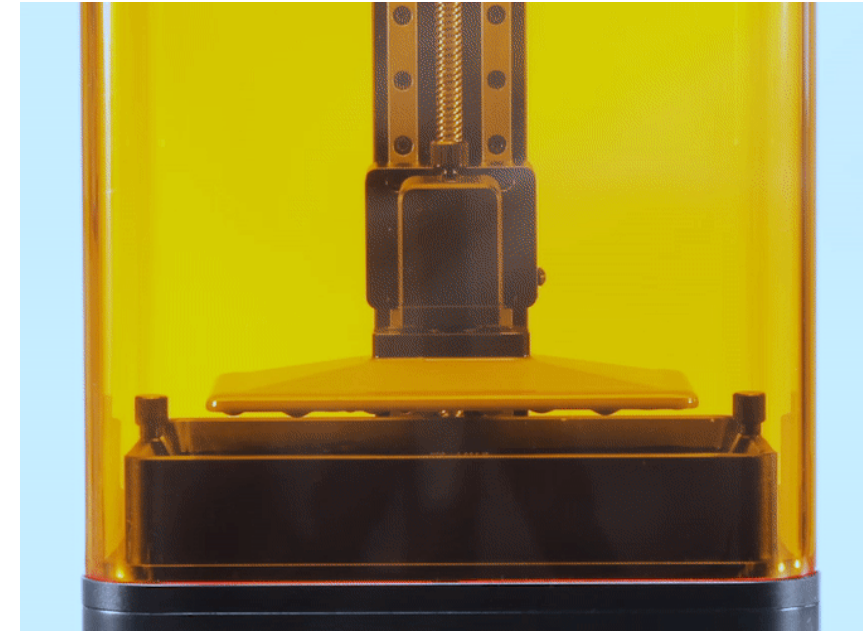
3D printer

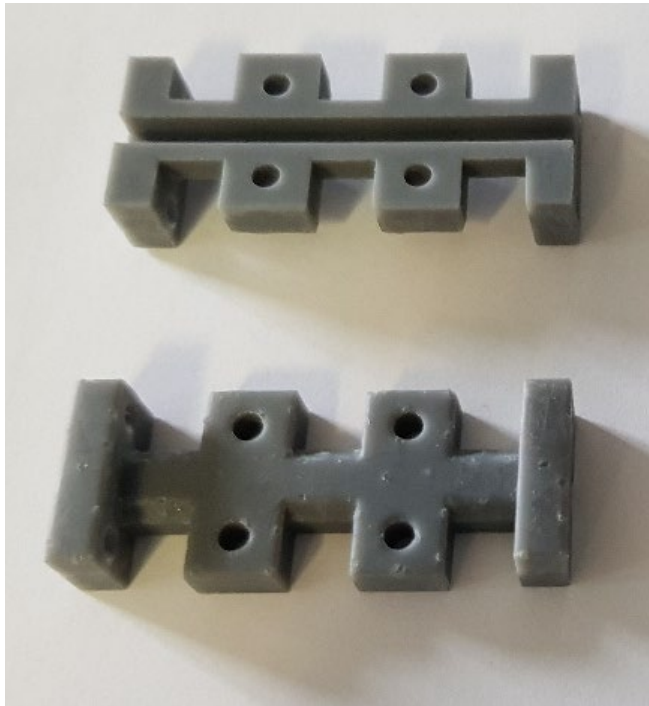


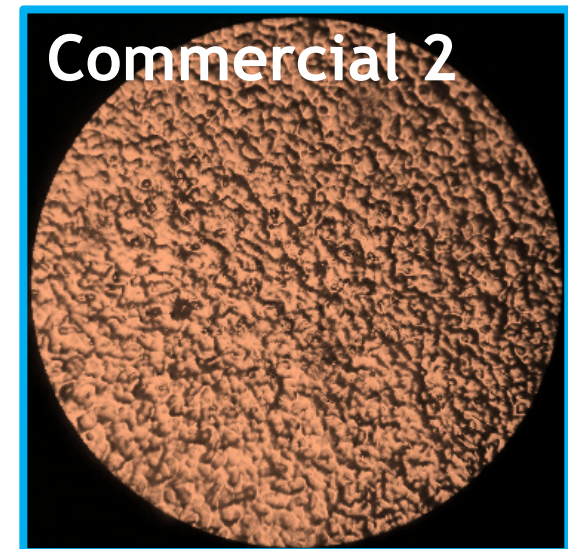
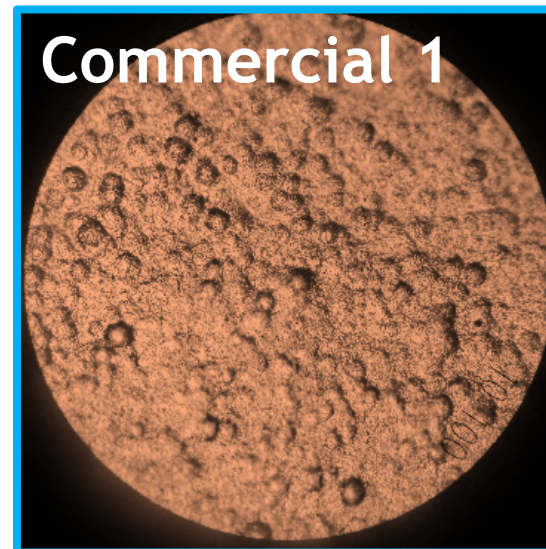
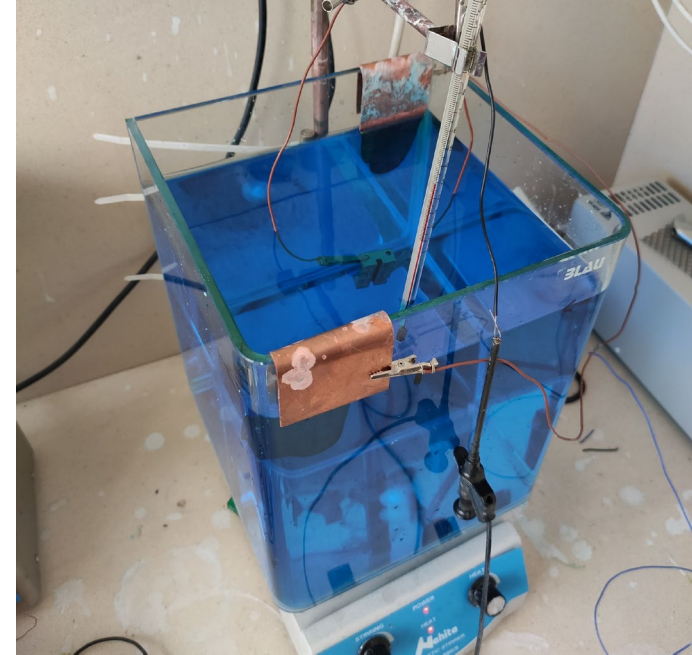
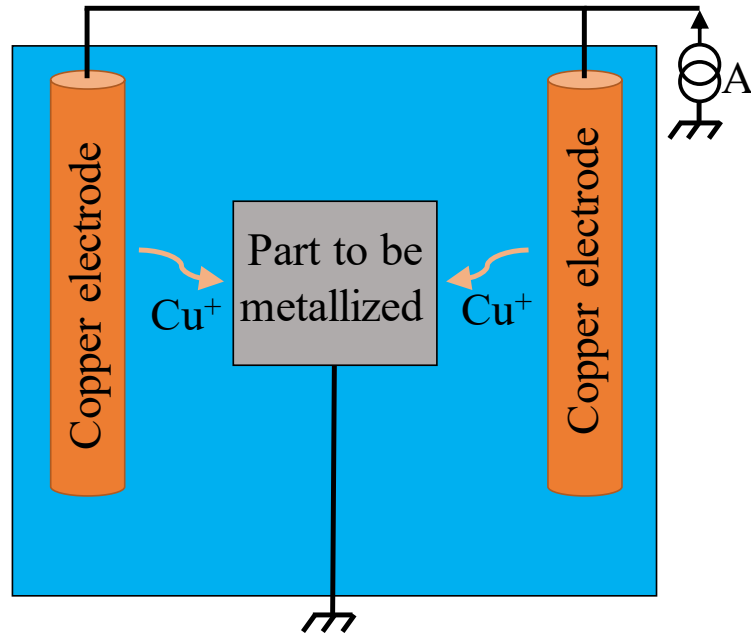
Cleaning with
alcohol



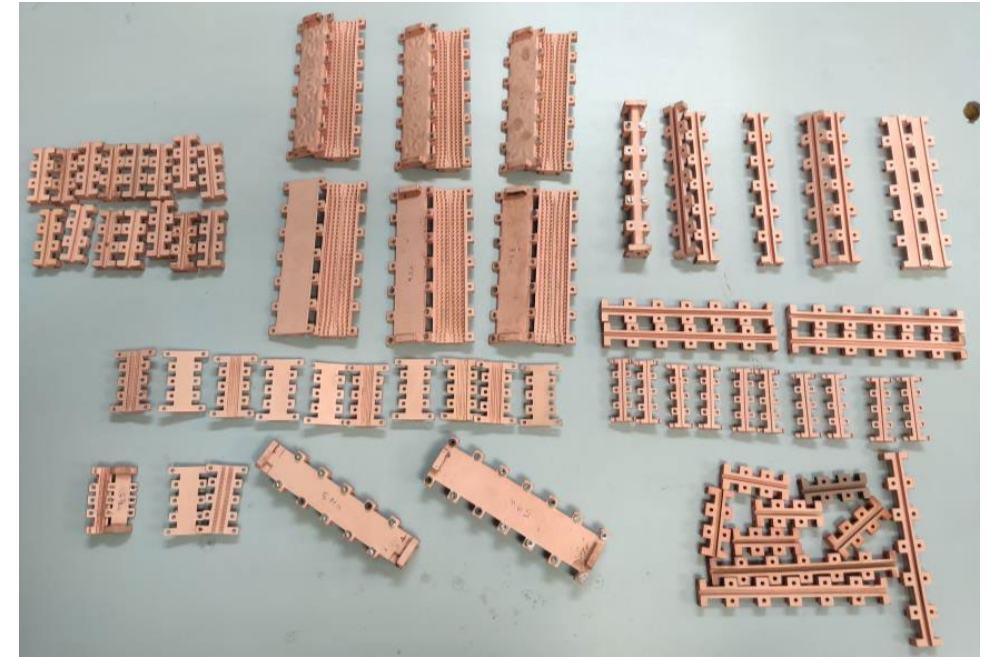
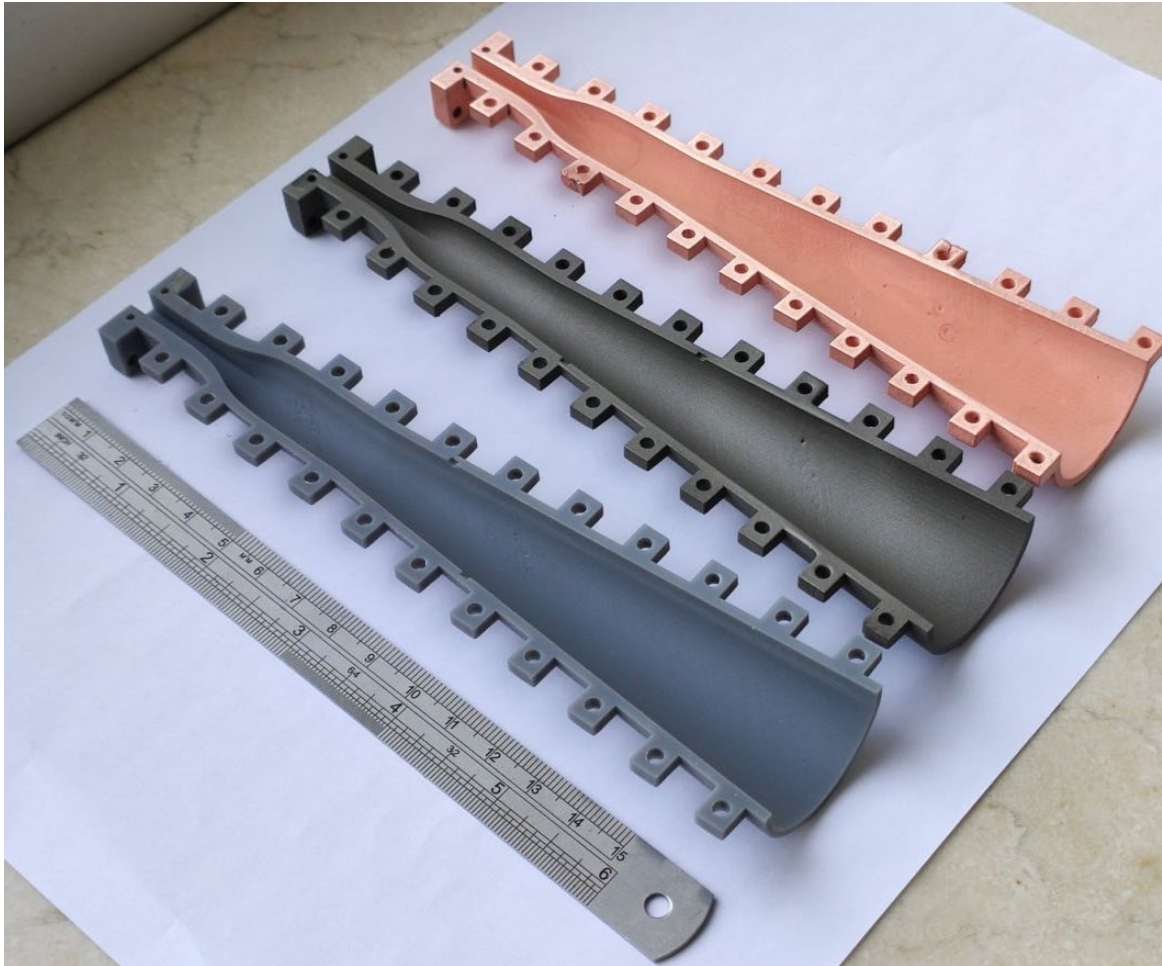
Curing process





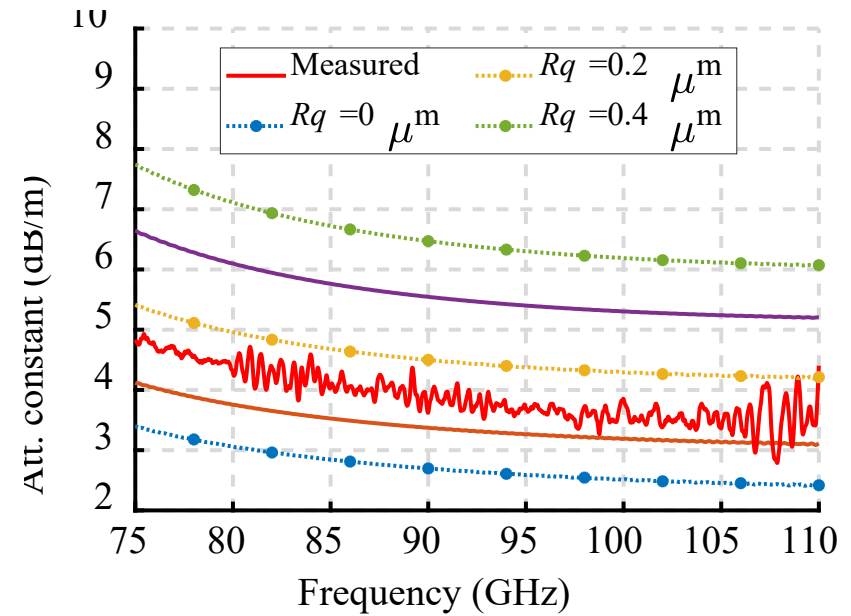
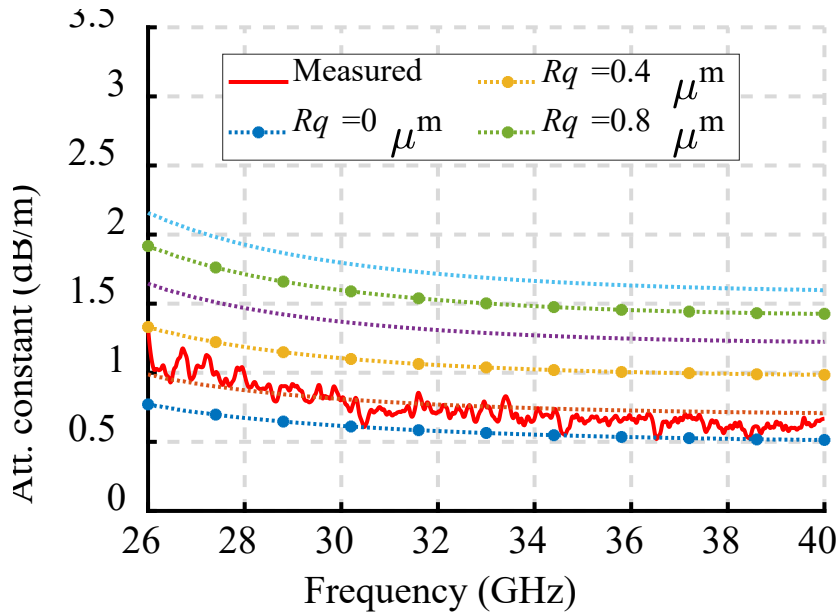
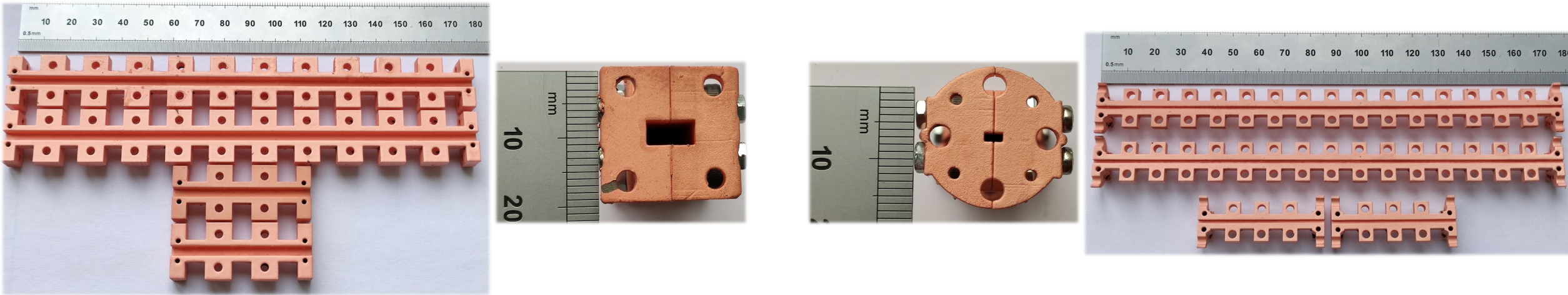


Rapid iteration process



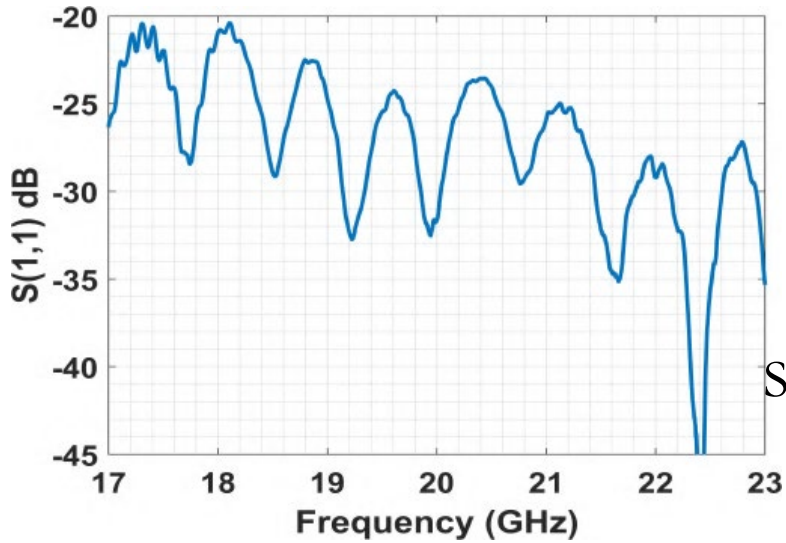
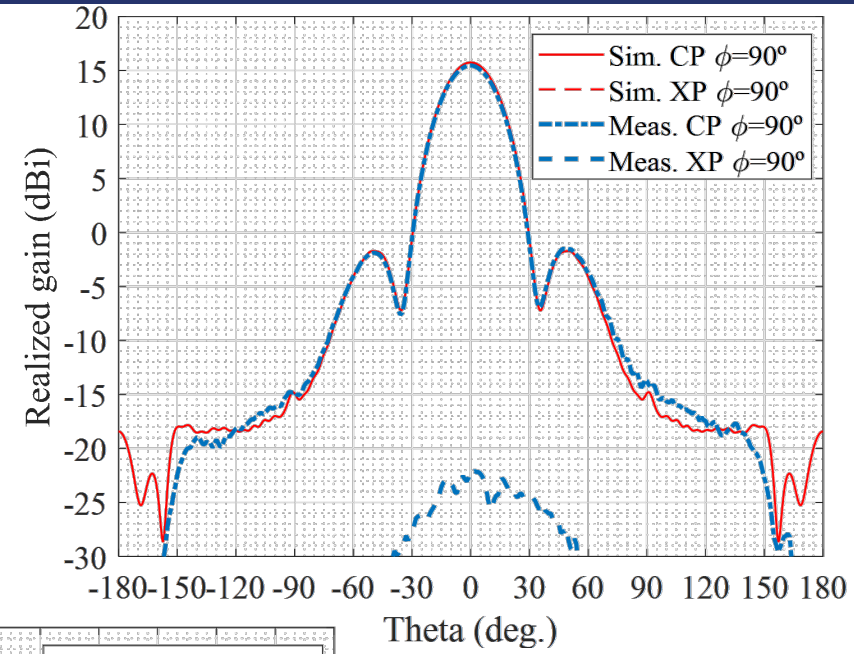
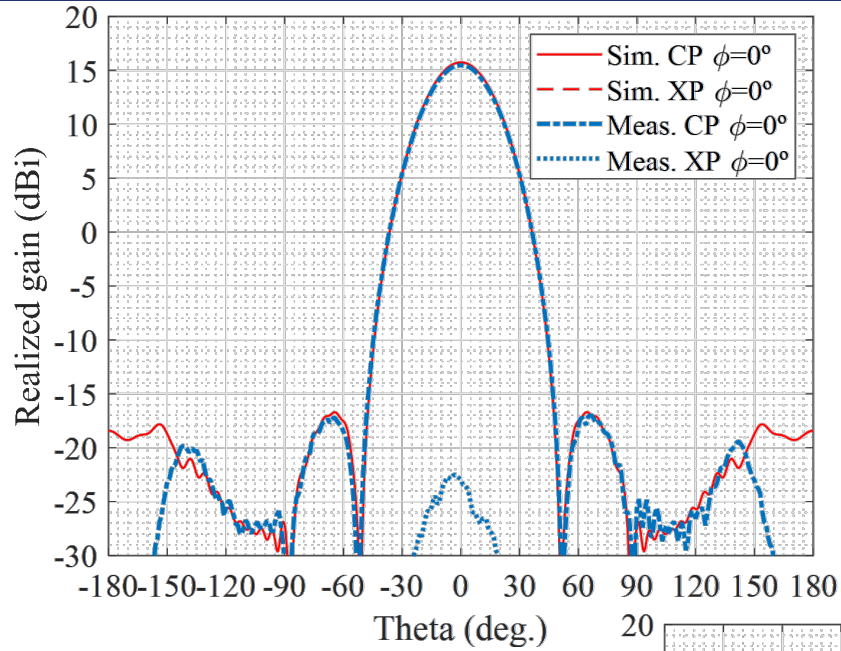
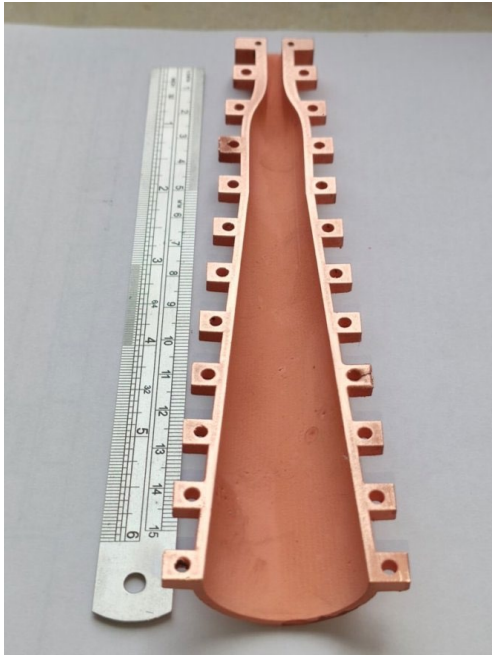
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3. Manufactured Devices. Waveguide parts

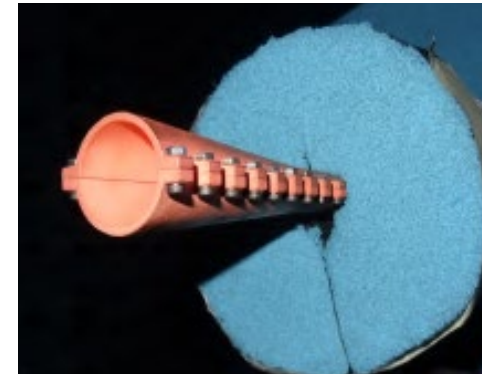
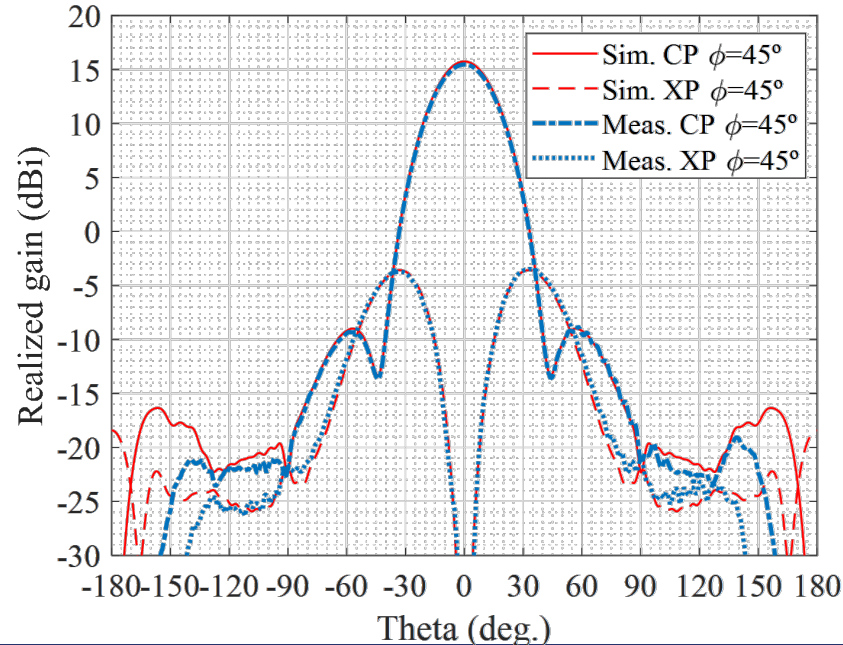


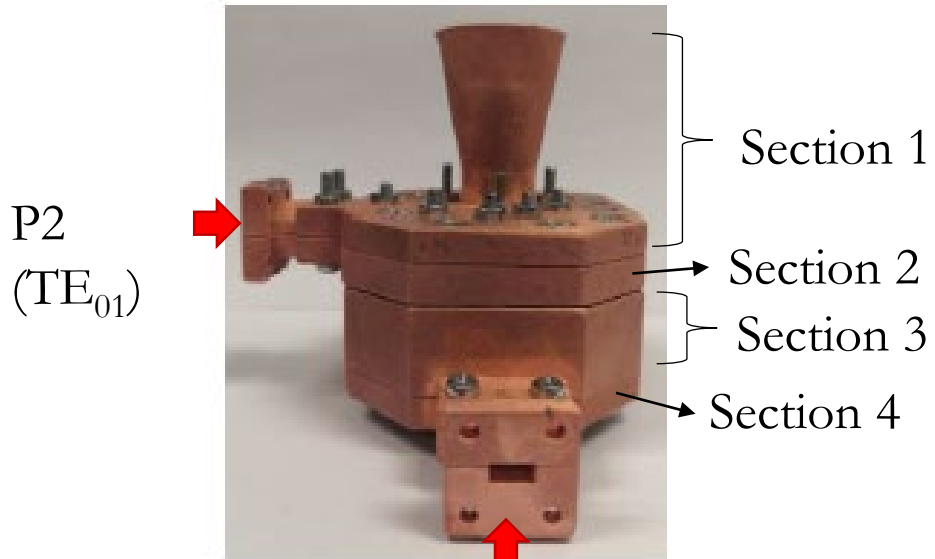
A. Tamayo-Dominguez, P. Sanchez-Olivares, A. Camacho-Hernandez and J. -M. Fernandez-Gonzalez, "Guidelines for Accurate in-House Electroplating and 3-D-Printing Processes Applied to mm-Wave Devices," in IEEE Microwave and Wireless Components Letters, vol. 32, no. 11, pp. 1267-1270, Nov. 2022

3. Manufactured Devices. Horn antennas

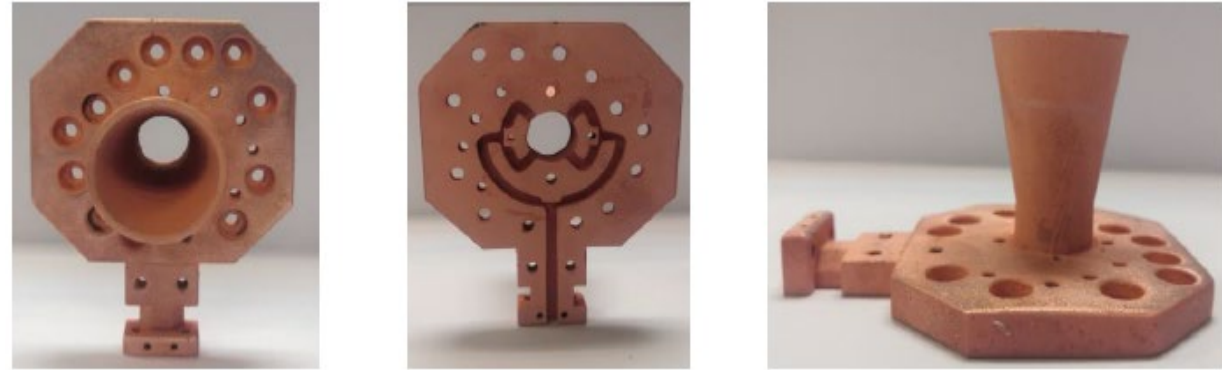


@20GHz

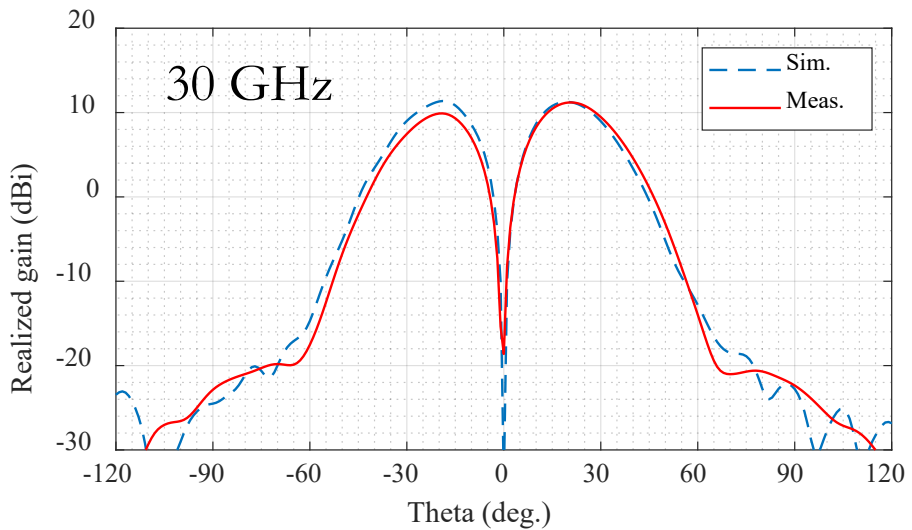
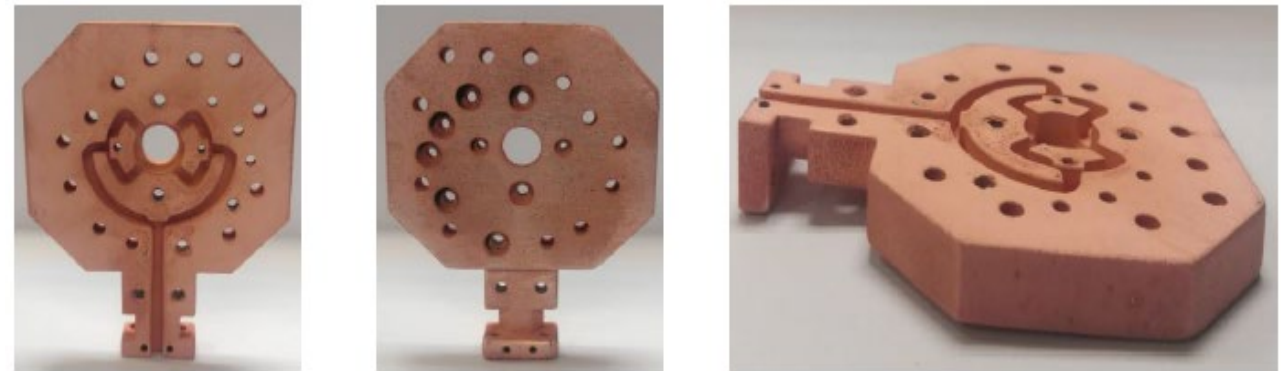




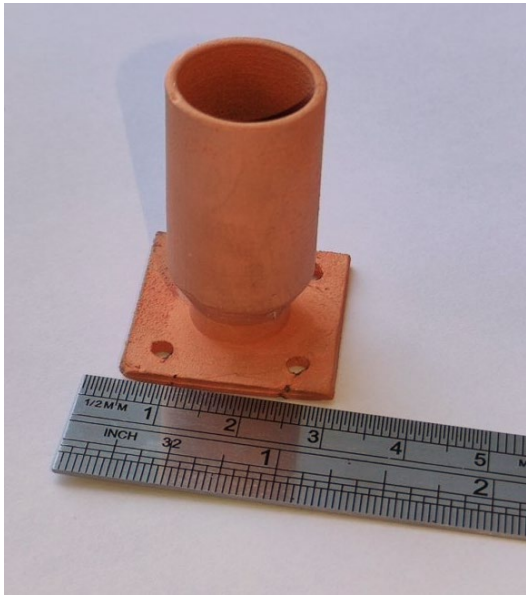
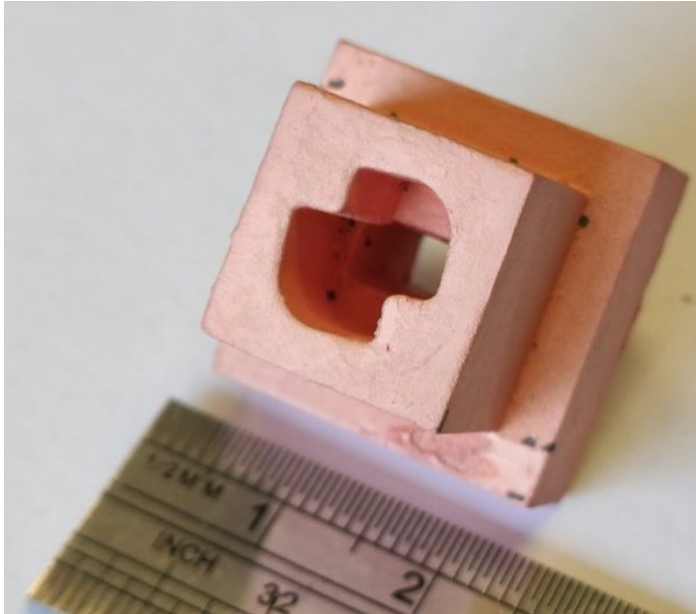
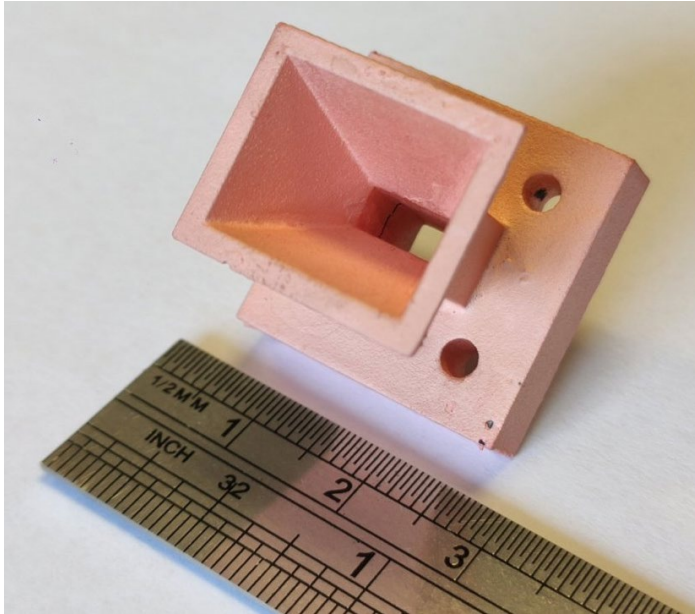
Section 1: Conical horn + TE_{01} mode converter



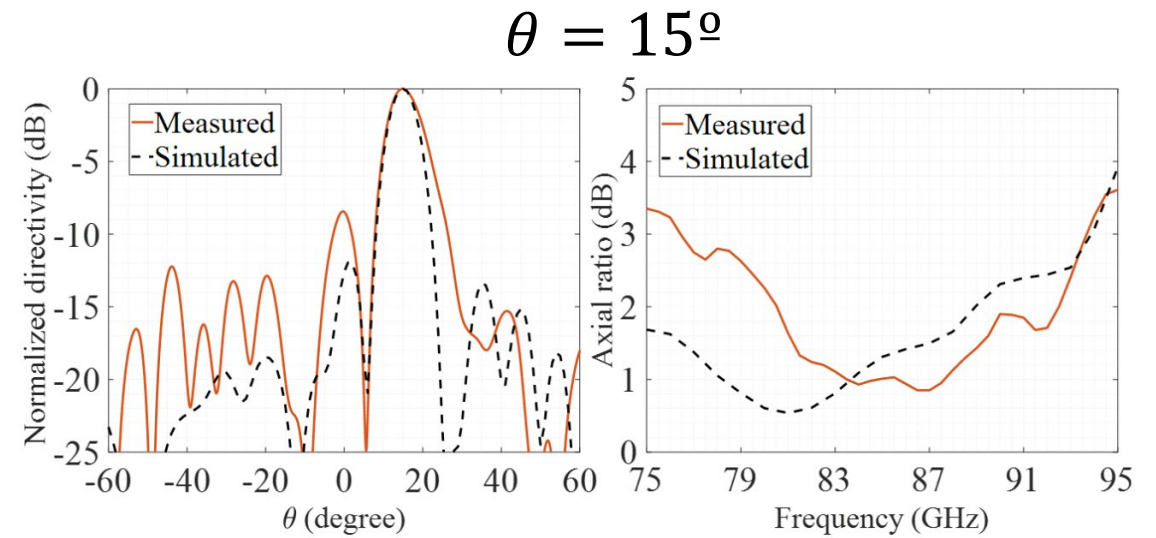
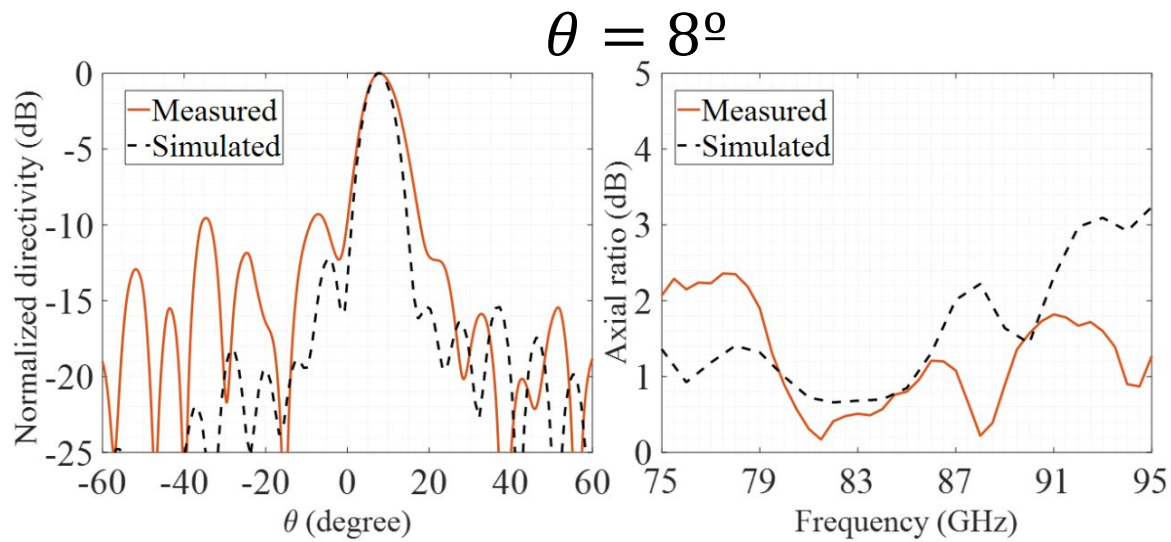
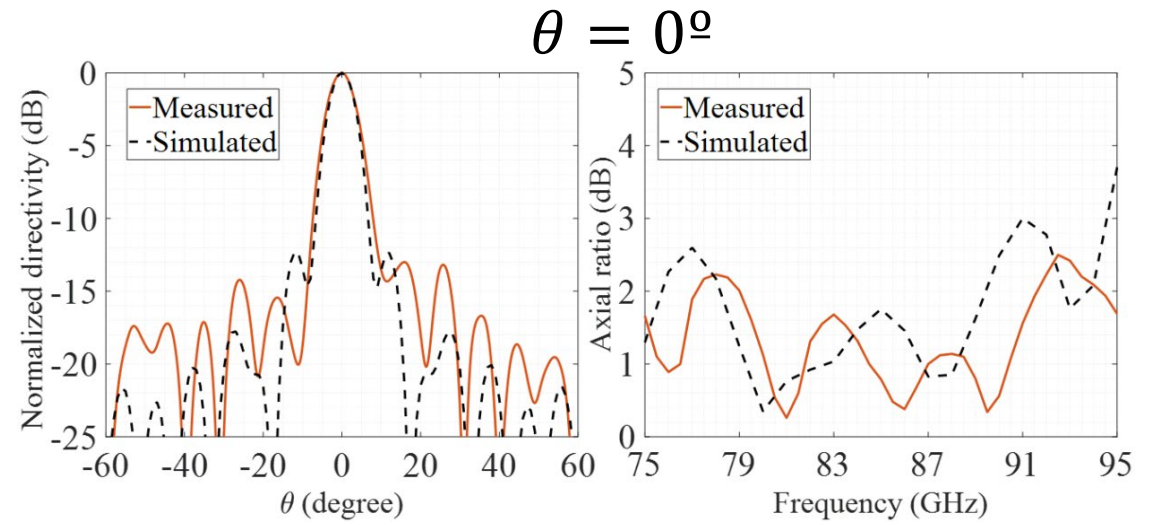
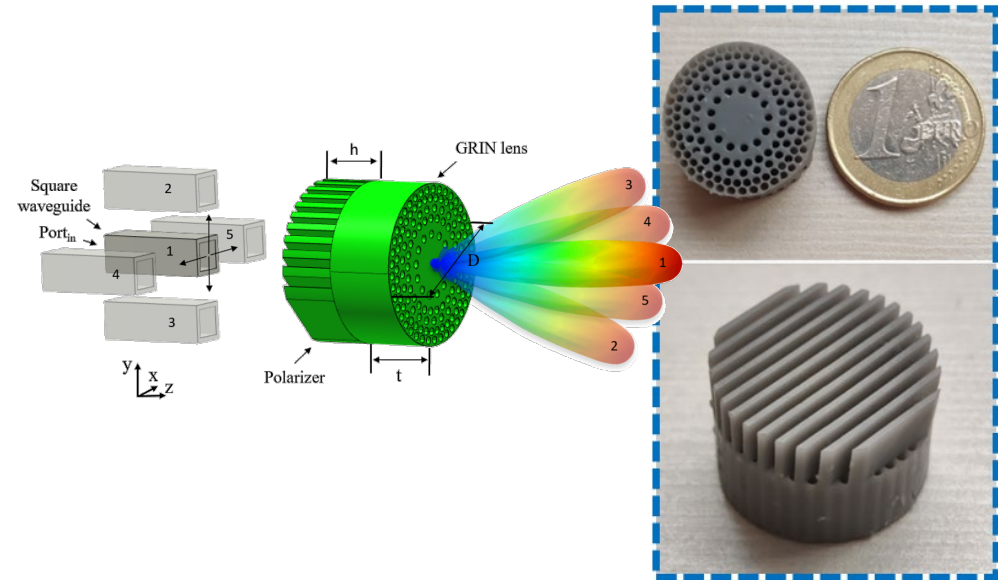
Section 2: TM_{01} mode converter



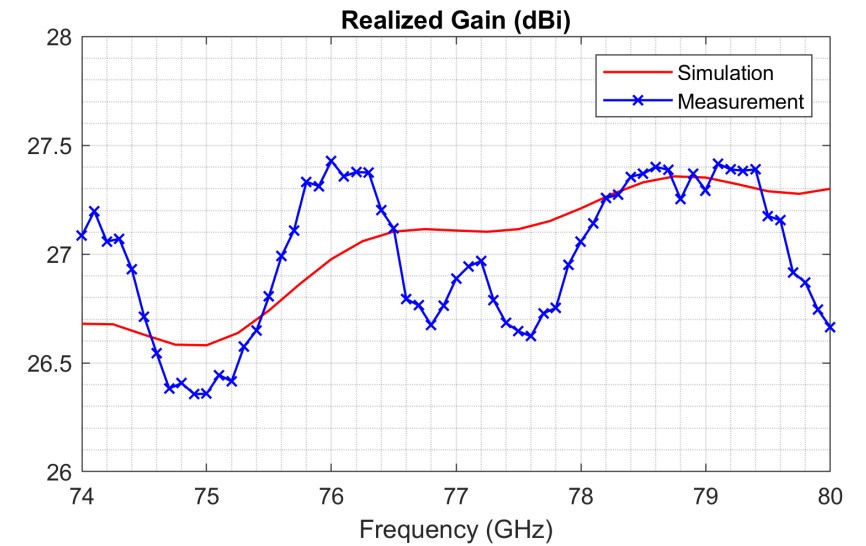
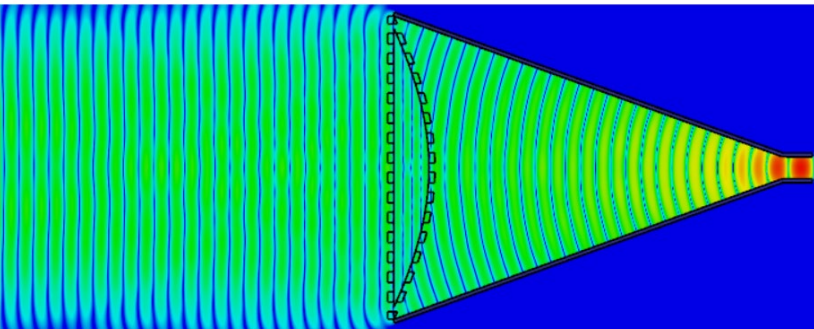
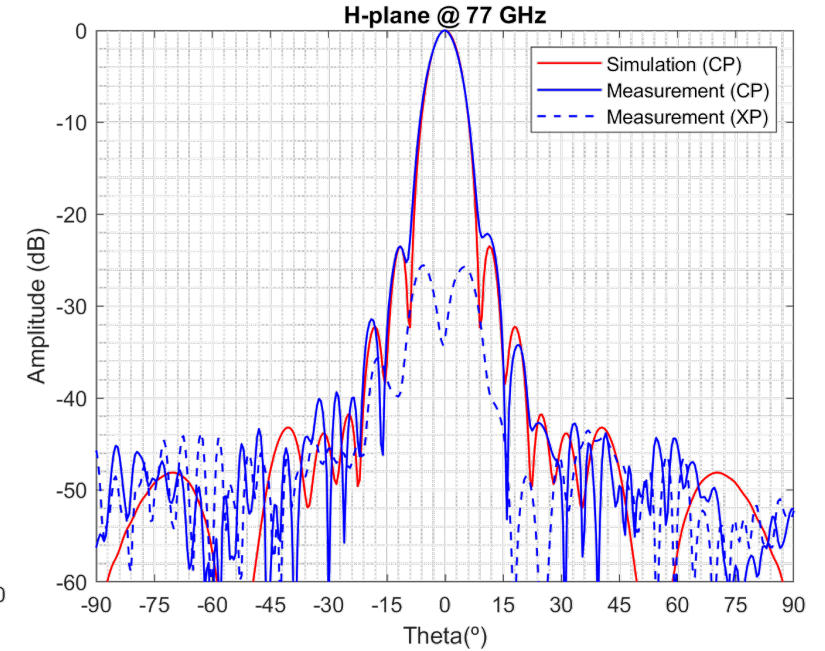
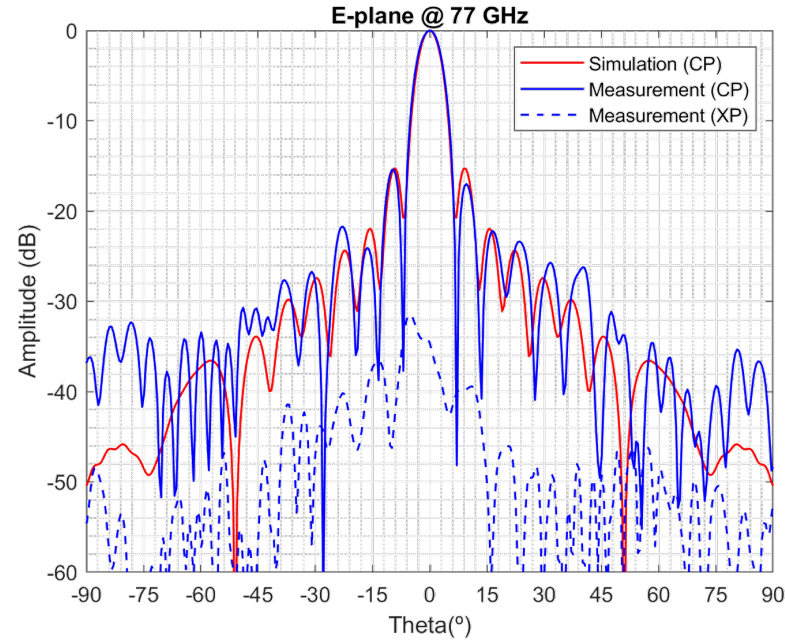
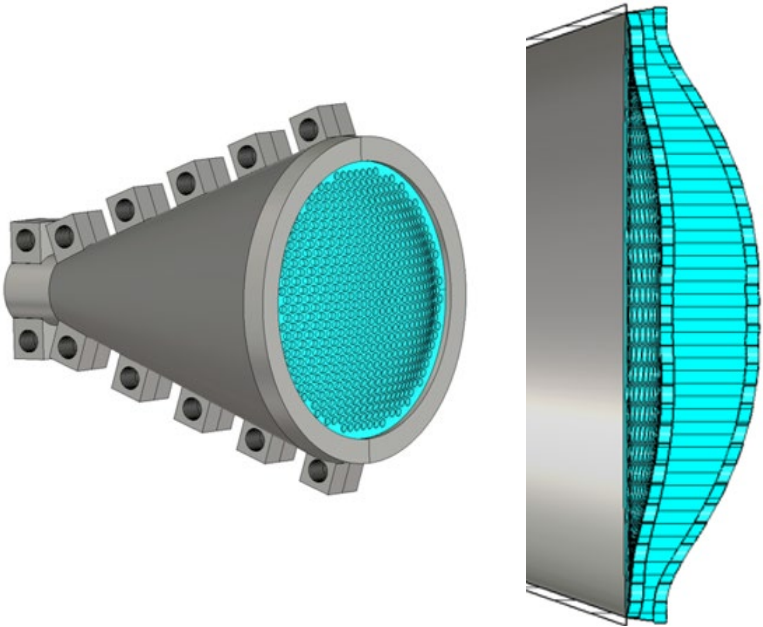
3. Manufactured Devices. Horn antennas

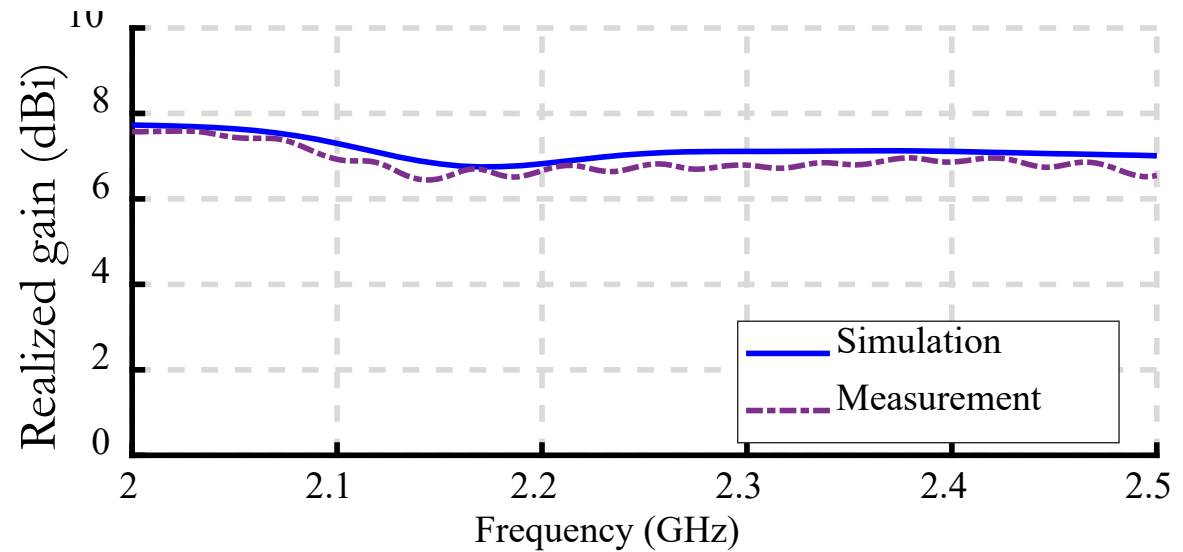
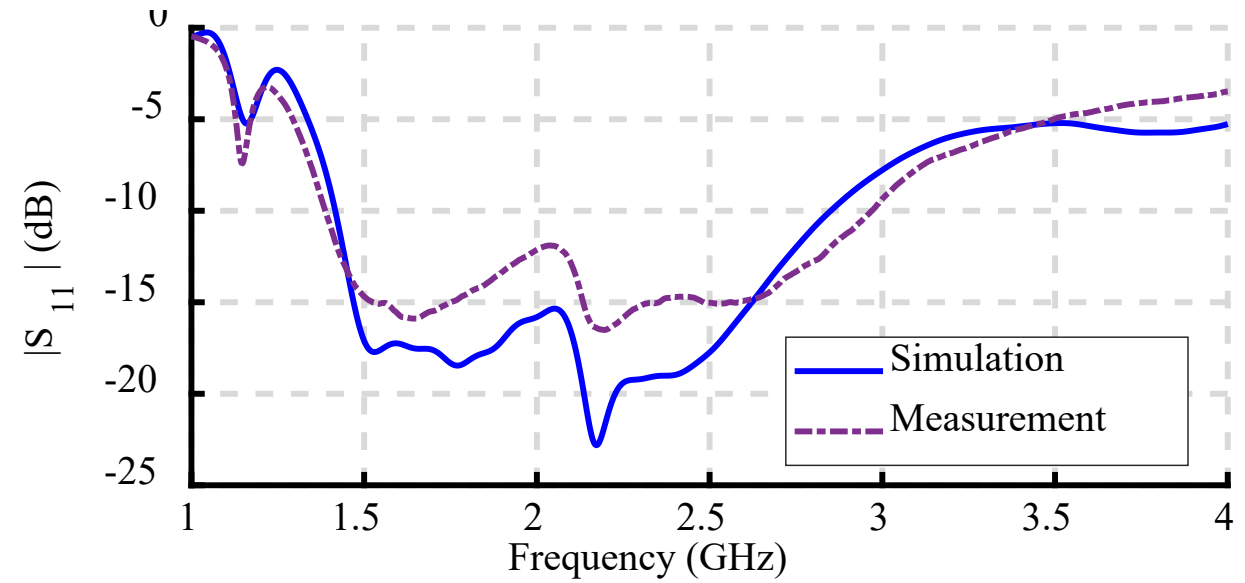
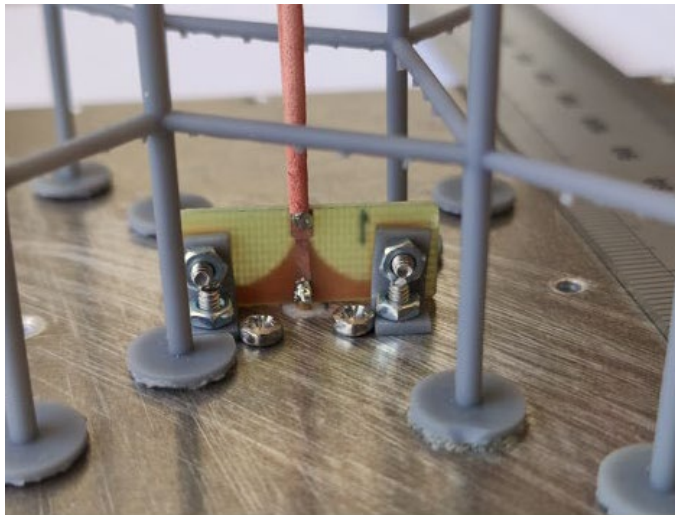
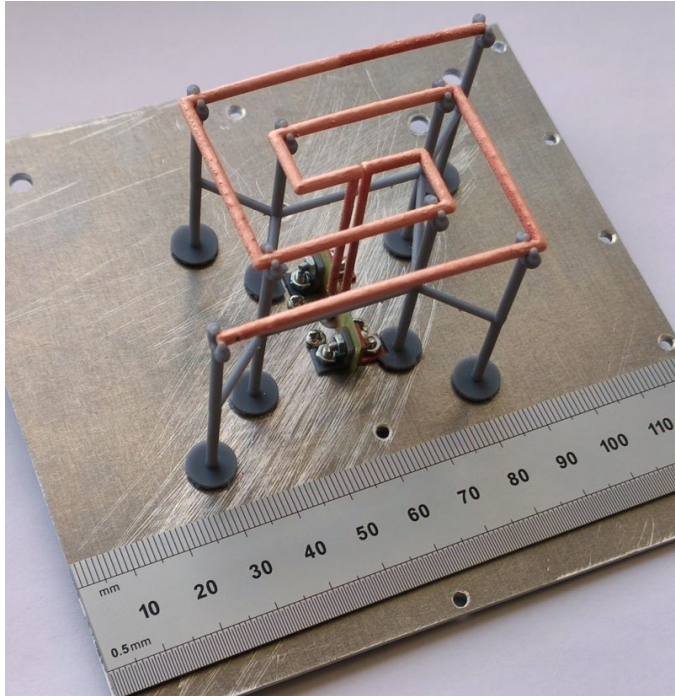


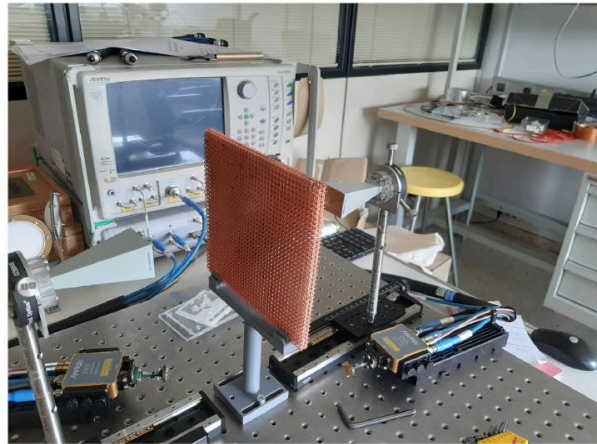
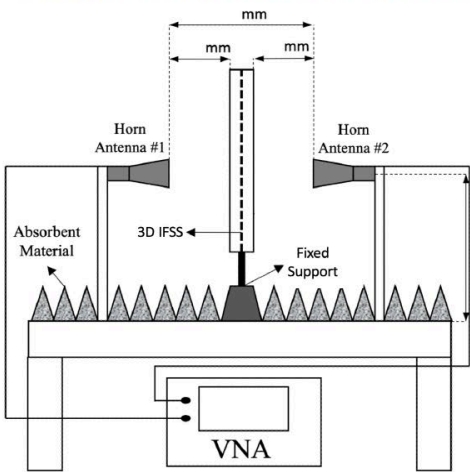
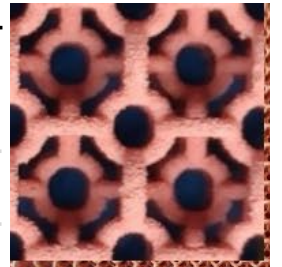
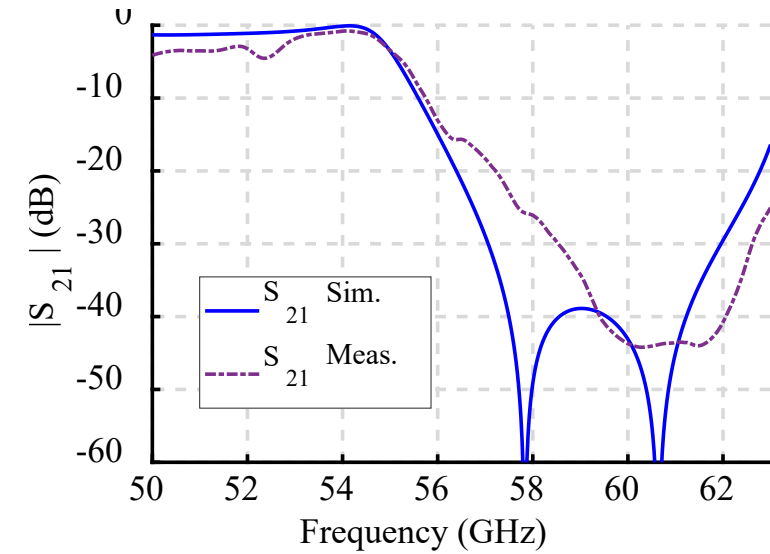
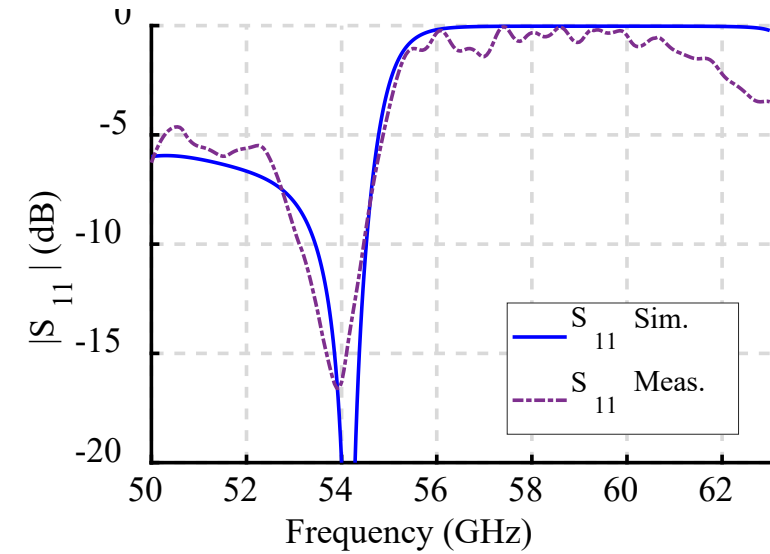
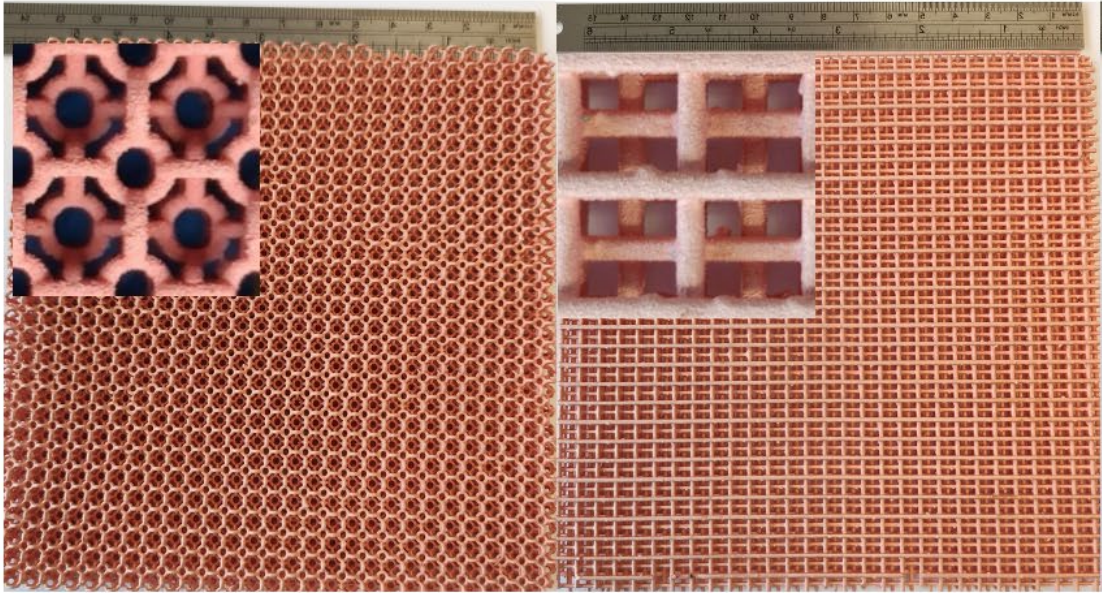
3. Manufactured Devices. Lenses and Dielectric Loadings



J. Melendro-Jimenez, P. Sanchez-Olivares, A. Tamayo-Dominguez, X. Sun and J. M. Fernandez-Gonzalez, "3D Printed Directive Beam-Steering Antenna Based on Gradient Index Flat Lens With an Integrated Polarizer for Dual Circular Polarization at W-Band," in IEEE Transactions on Antennas and Propagation, vol. 71, no. 1, pp. 1059-1064, Jan. 2023







J.A. Vásquez-Peralvo; A. Tamayo-Domínguez; G. Pérez-Palomino; J.M. Fernández-González; T. Wong, “3D Inductive Frequency Selective Structures Using Additive Manufacturing and Low-Cost Metallization”. *Sensors* 2022, 22, 552. <https://doi.org/10.3390/s22020552>

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- **Simple, low-cost** metal plating process.
- **Versatile and cost-effective** 3D printing set-up.
- **Rapid** iteration process.
- High **quality** behaviour up to **110 GHz**.
- Good performance applied to many **form-factor** antennas: horns, dielectric lenses, spirals, 3D FSSs, waveguide devices...
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