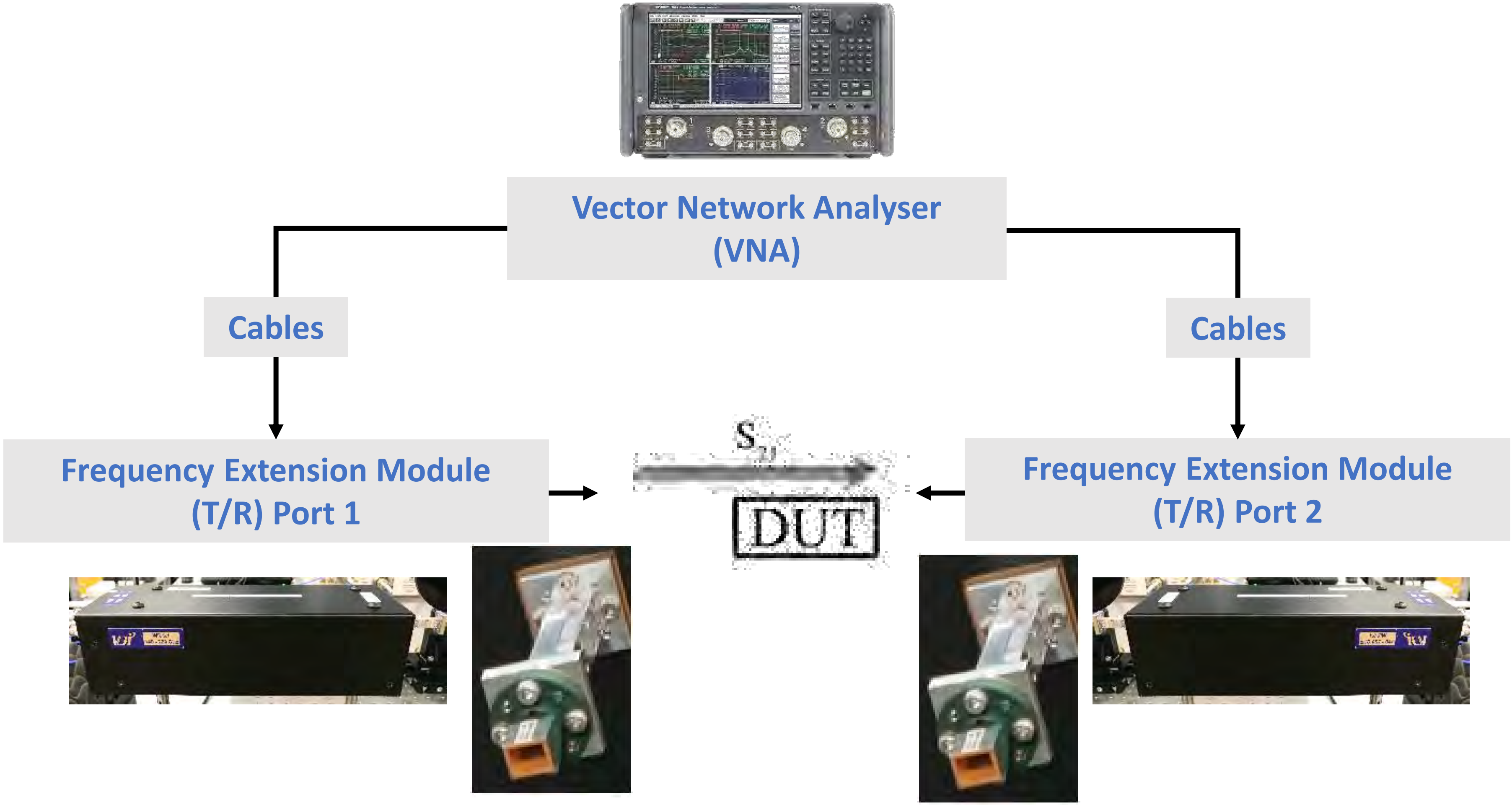
Copper Electroplating

- 3DDC Ltd (Newport Pagnell)
- Technical Copper Plating
  - Waveguides and Horns
- Mirror Copper Plating
  - Off-axis parabolic mirrors

Gold-leaf Gilding

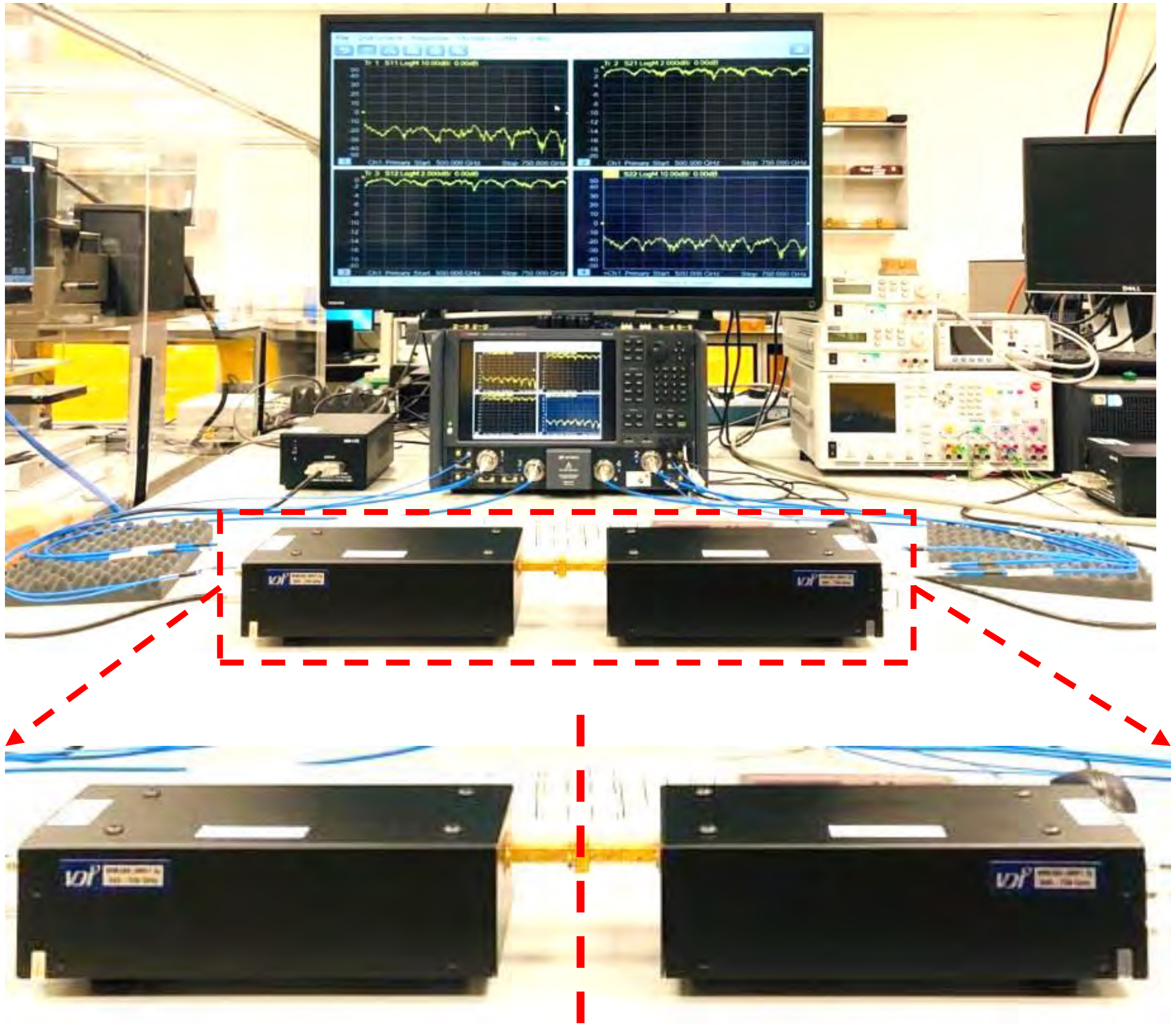
- Preheating the components
  - 60°C on hotplate
- Applying adhesive
  - Liquid glue for gilding
  - Drying with induction heater
- Gold-leaf Gilding
  - Depositing 23.75 carat gold-leaf on glued surfaces
  - Remove excess material using fine brush

NPL PNA-X Vector Network Analyser

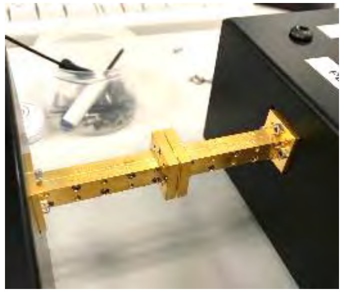


G-band waveguide standard size: WM1295 (width 1.295 mm, height 0.6475 mm)

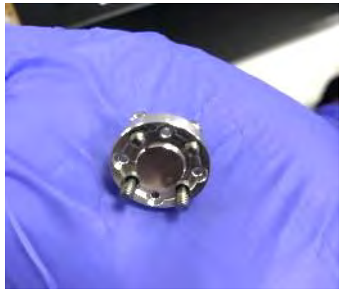
2-Port VNA Calibration



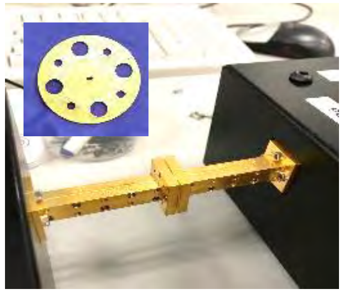
Calibration Plane



Through



Reflect (Short)



Line (λ/4 shim)

- Calibration necessary to remove noise and unwanted effects from the cables and the system
- 2-port TRL calibration used
- Fix the calibration planes to waveguide flange end of both frequency extension module

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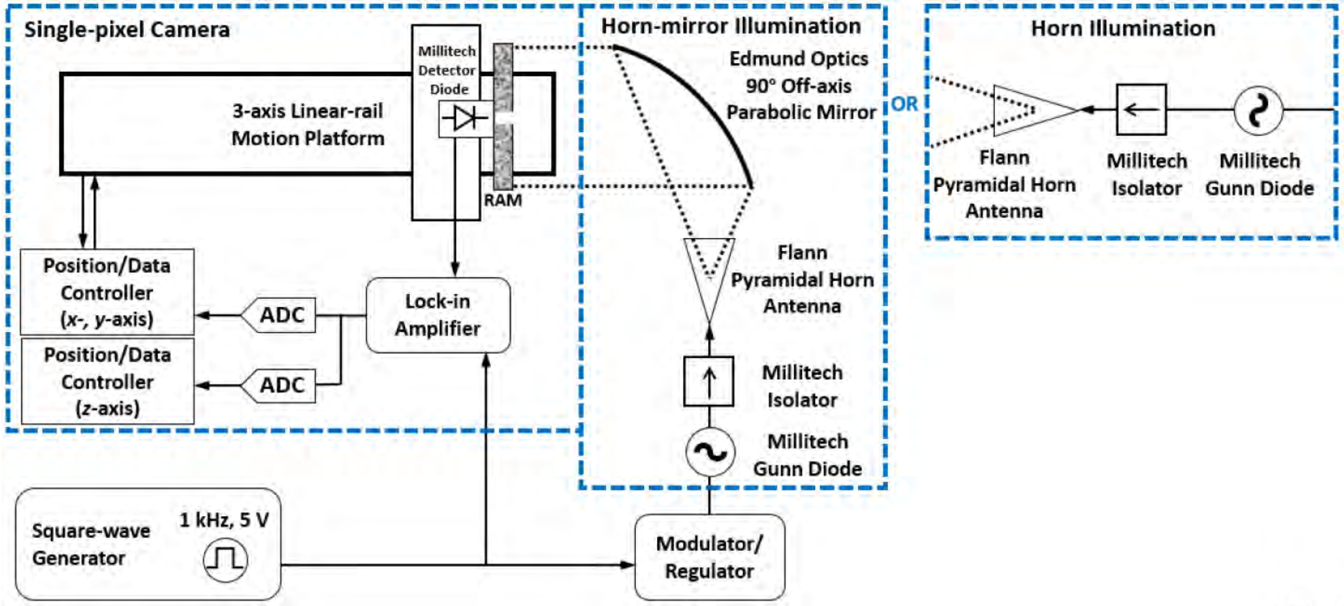
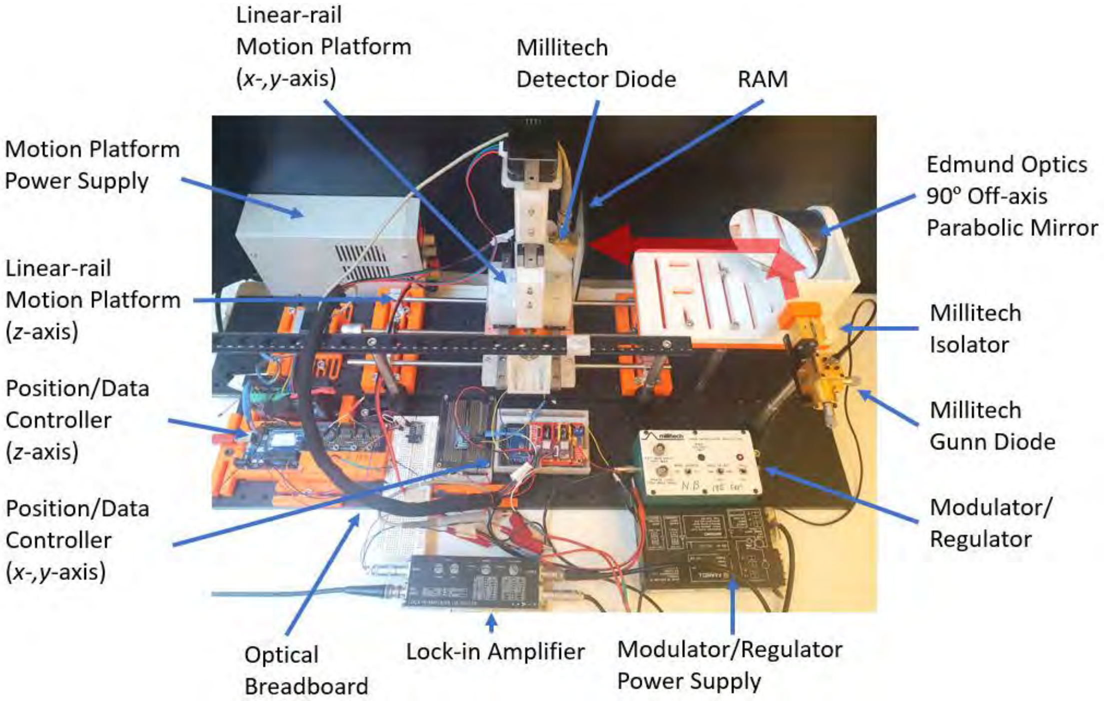
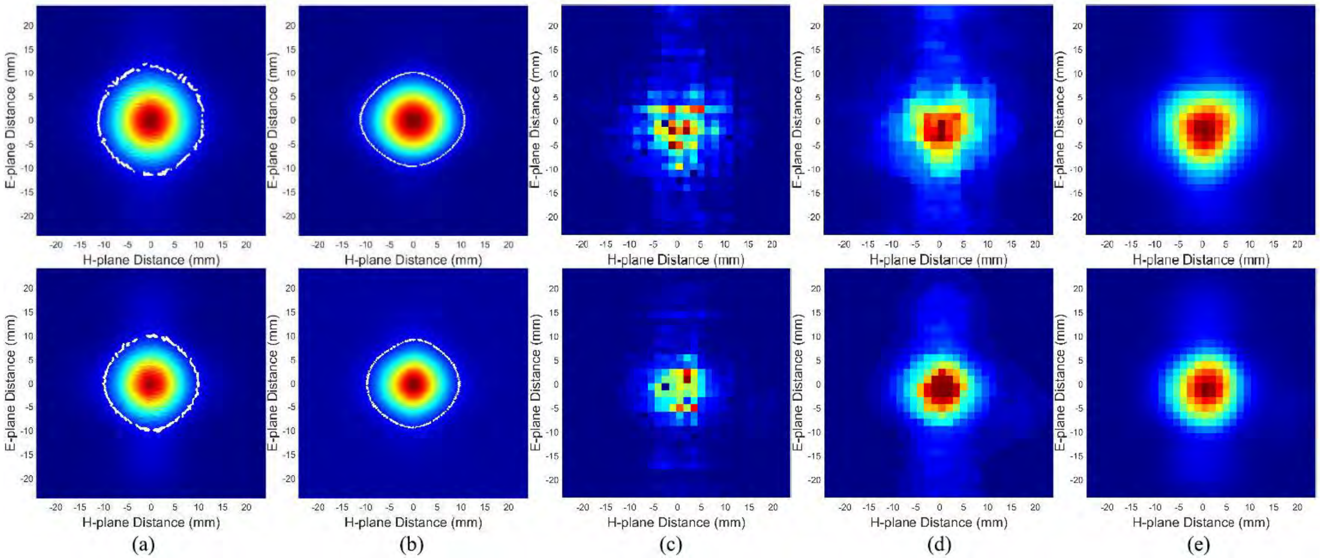
Benchmarking a Commercial (Sub-)THz Focal Plane Array Against a Custom-Built Millimeter-Wave Single-Pixel Camera

SANG-HEE SHIN, (Graduate Student Member, IEEE), AND STEPAN LUCYSZYN, (Fellow, IEEE)
Department of Electrical and Electronic Engineering, Imperial College London, London SW7 2AZ, U.K.







EM Simulated and measured diverging beam cross section images (normalized values) at 76 GHz (above) and 92 GHz (below) with a 30 mm separation distance between antenna and camera apertures: (a) Reference HFSS simulation (raw); (b) single-pixel camera (raw); (c) TeraSense camera (raw); (d) TeraSense camera (proprietary median-smooth filter); and (e) TeraSense camera (MATLAB ‘disk smooth’ filter). The white loci represent the extracted $1/e^2$ boundaries.

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Polymer-Based 3-D Printed 140-220 GHz Low-Cost Quasi-Optical Components and Integrated Subsystem Assembly

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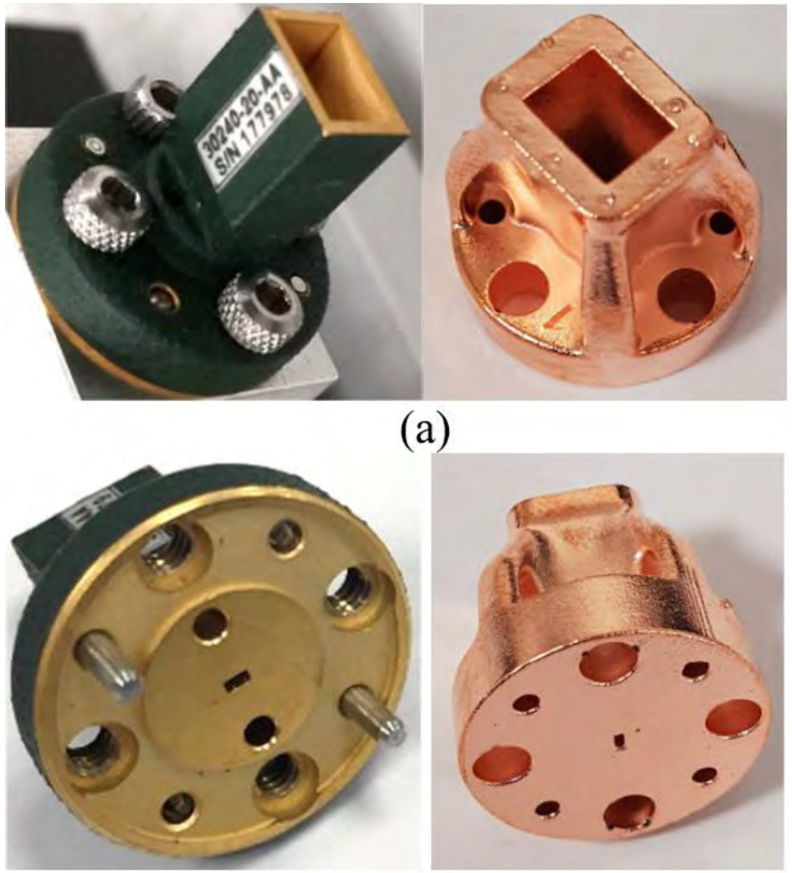
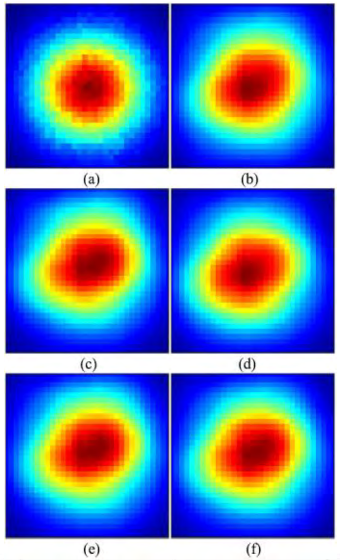
[1]Department of Electrical and Electronic Engineering, Imperial College London, London SW7 2AZ, U.K.

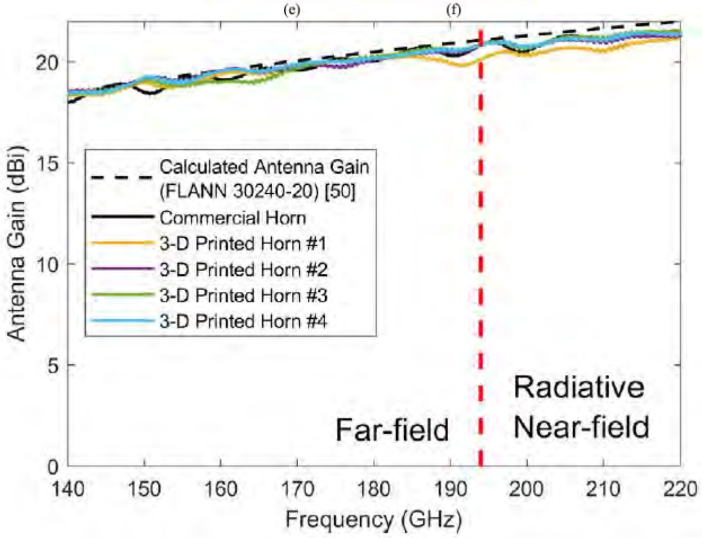
[2]National Physical Laboratory, Department of Electromagnetic and Electrochemical Technologies, Teddington TW11 0LW, U.K.

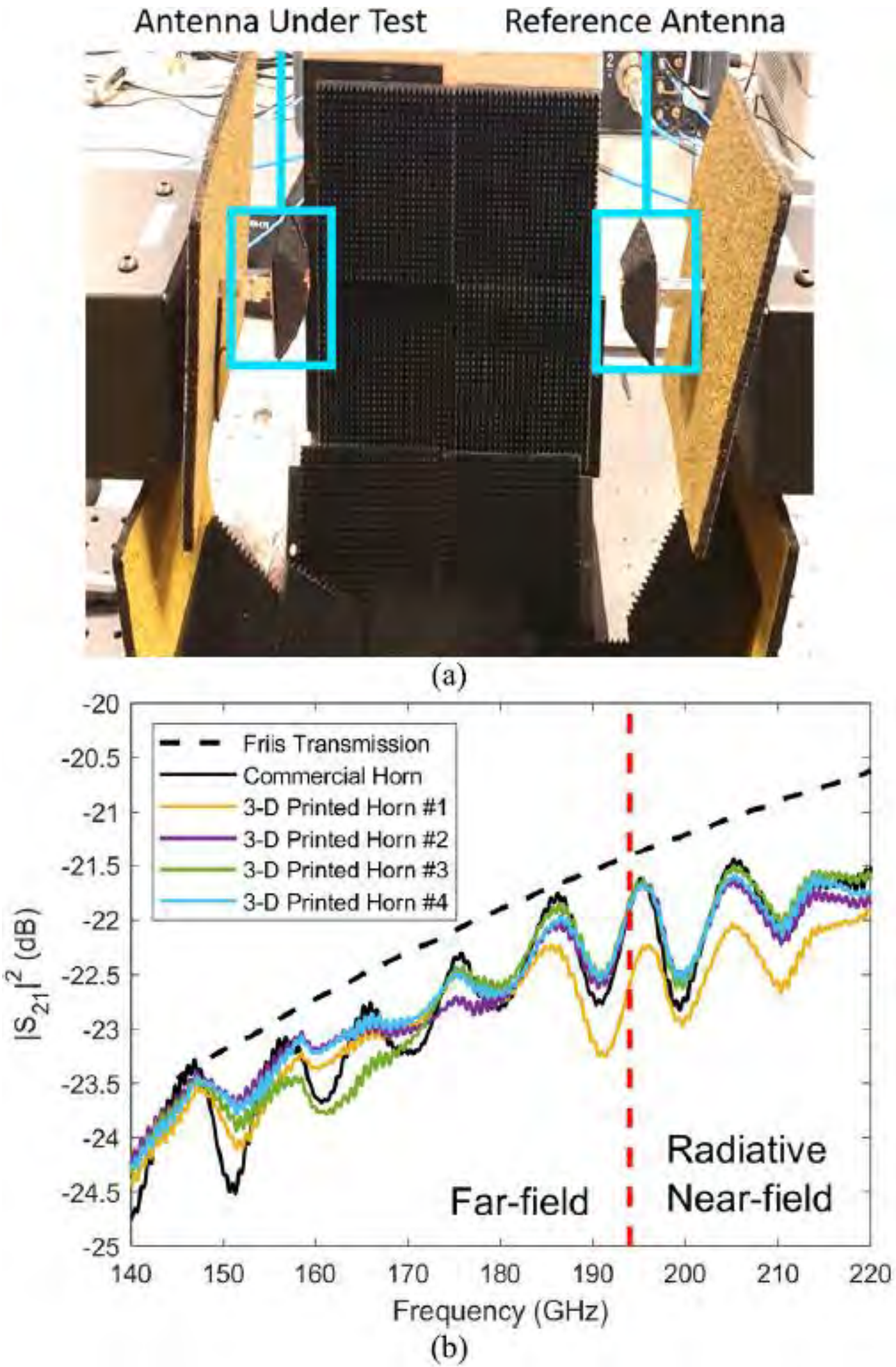


(a)

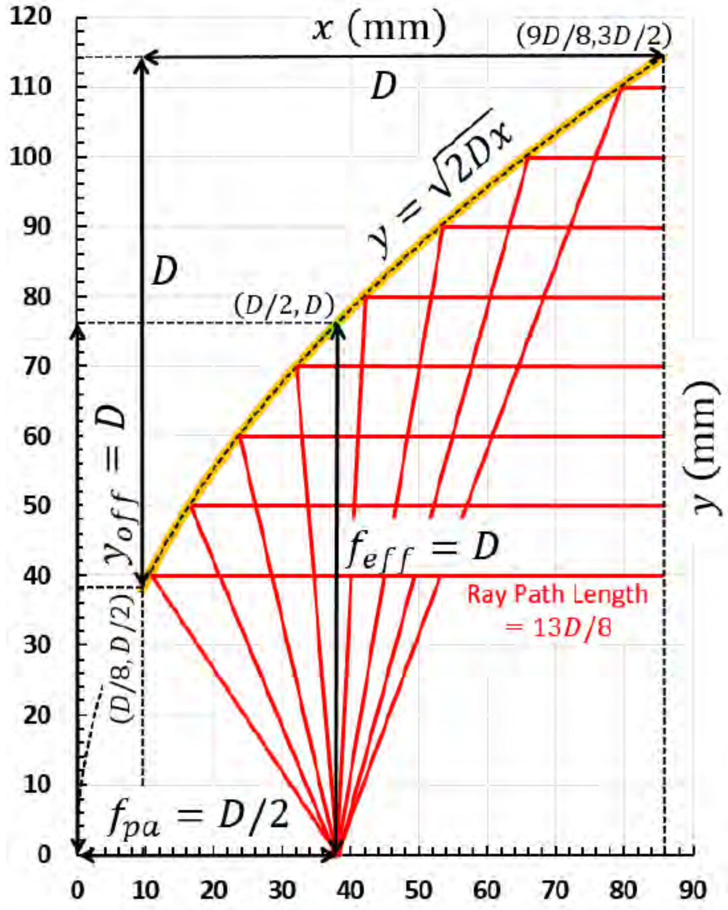
(b)

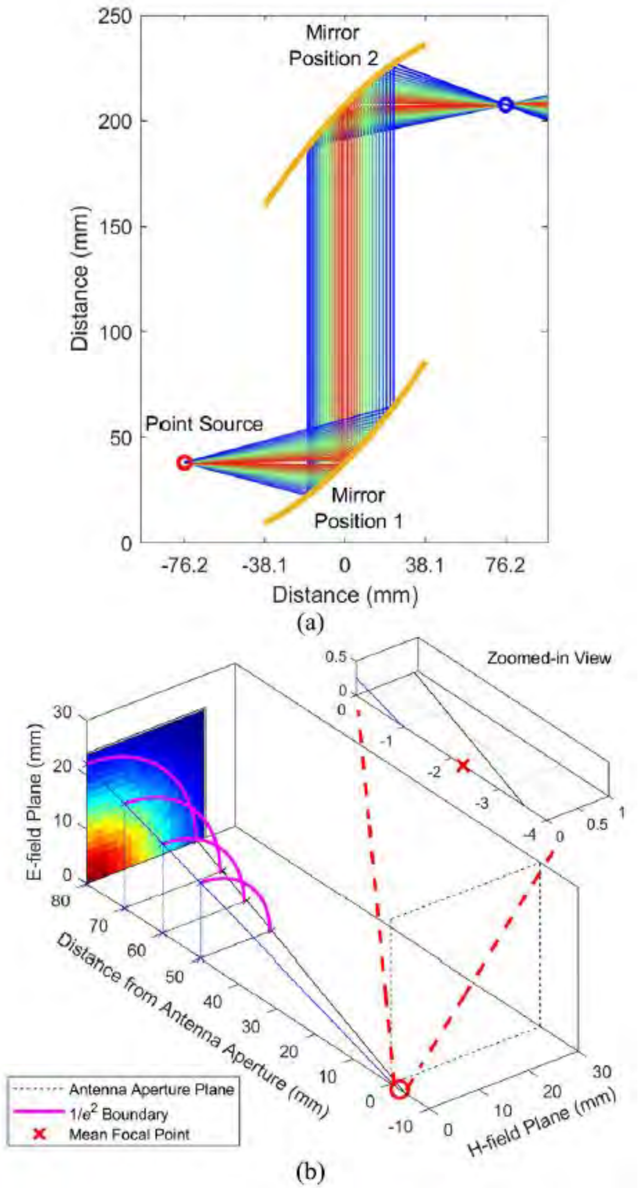


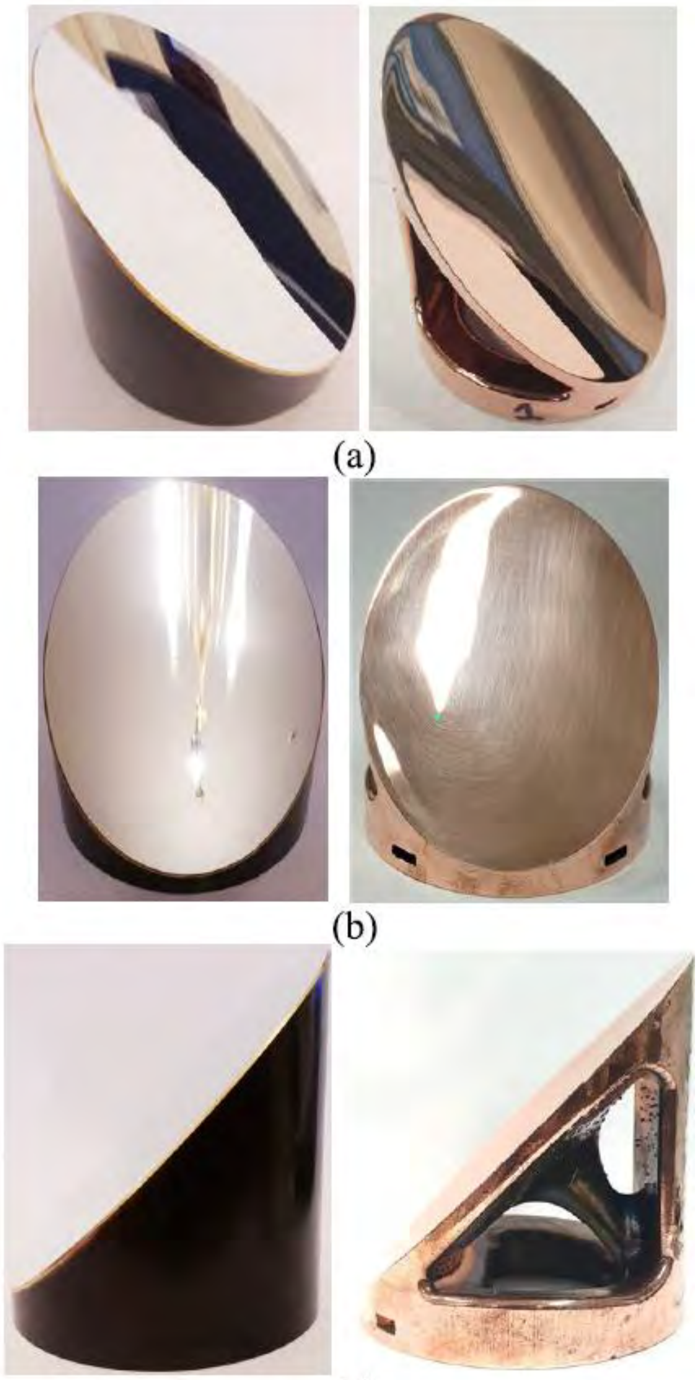




Transmission measurement setup and results for the rectangular horn antennas: (a) test setup showing the commercial horn antennas surrounded by commercial RAM; and (b) measured transmission coefficients for the commercial counterpart and replica antennas. The red dashed line shows the boundary between the far field and radiative near field.

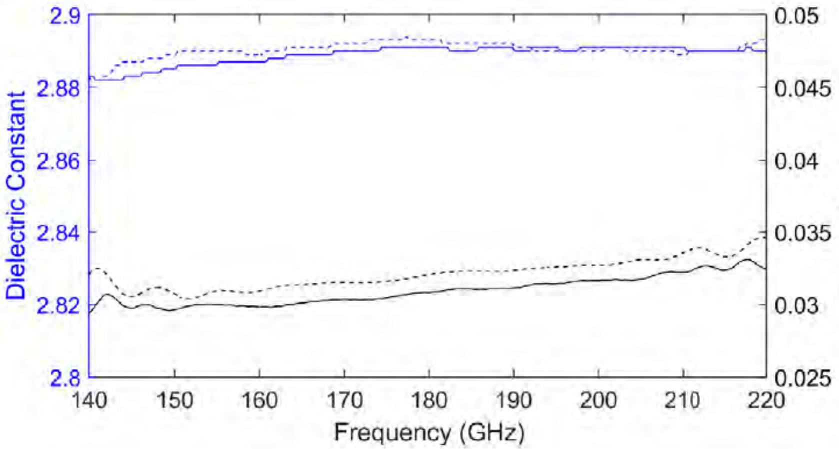


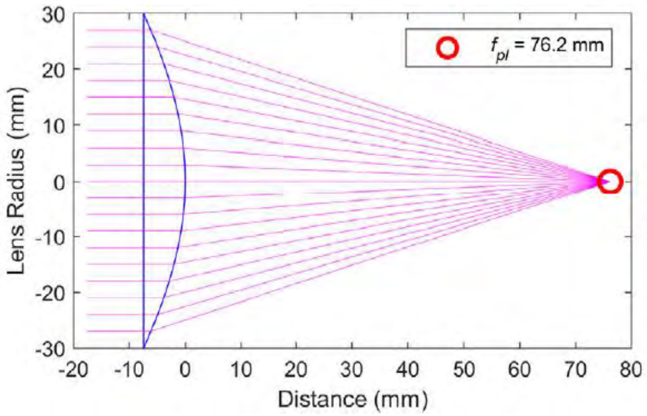


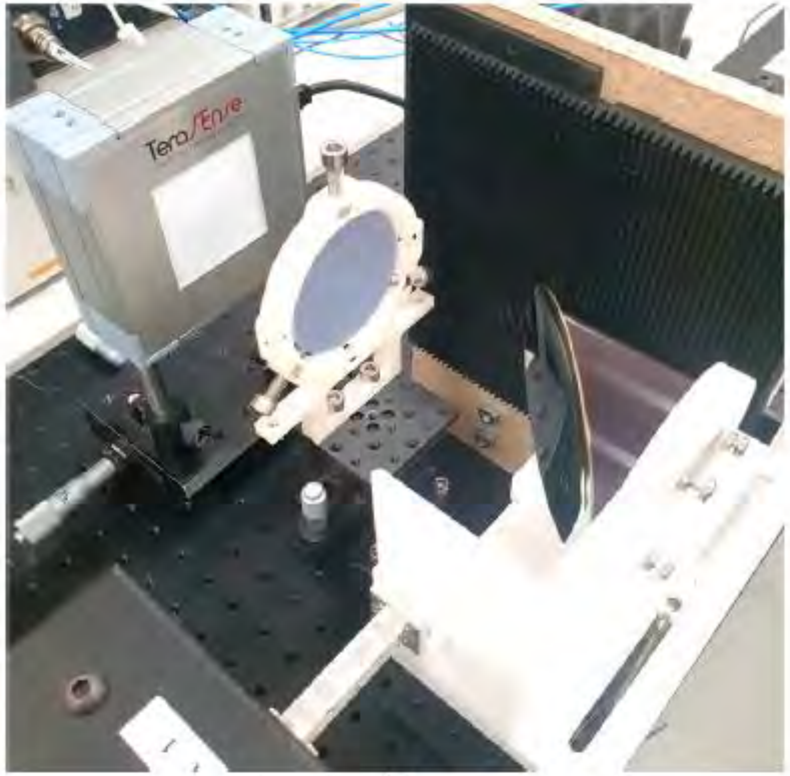


(c)

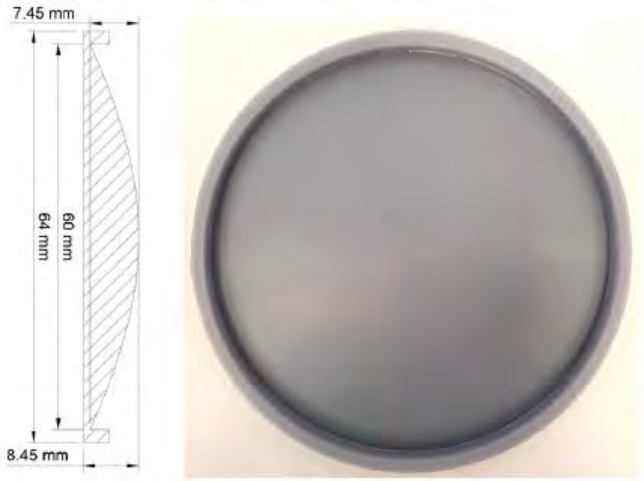
Photographs of commercial counterpart (left) and mass-reduced 3-D printed modified replica (right) 90 off-axis parabolic mirrors: (a) isometric views; (b) front views; and (c) side views.

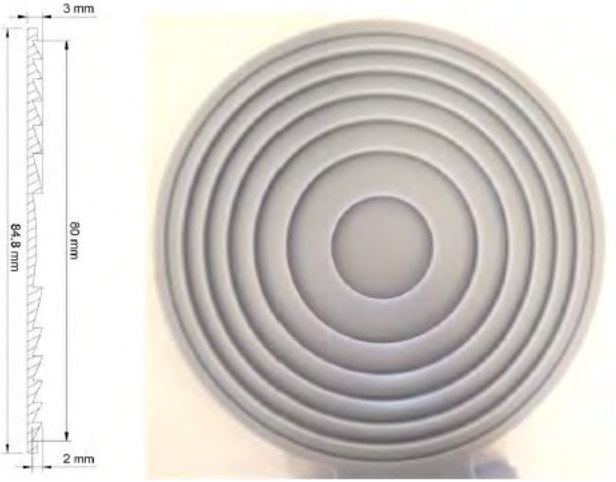


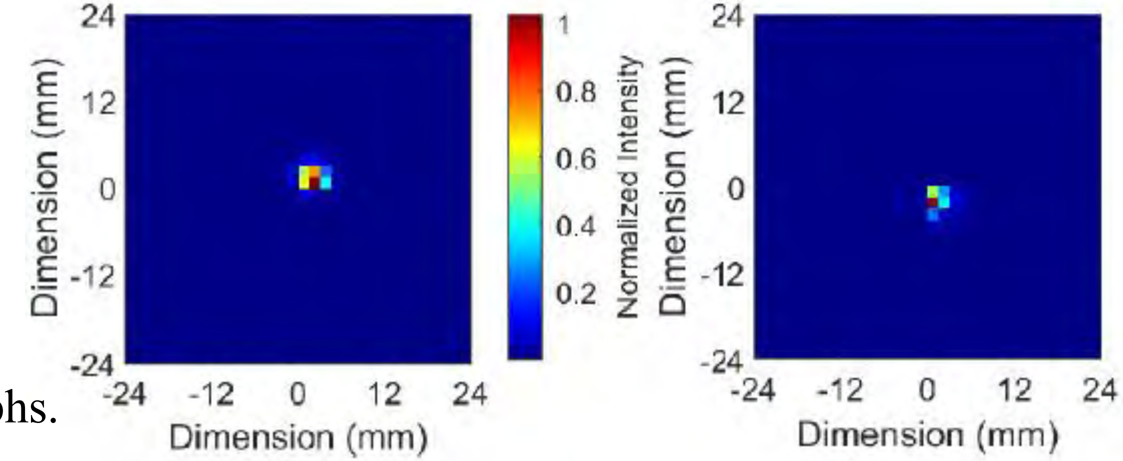




(a)

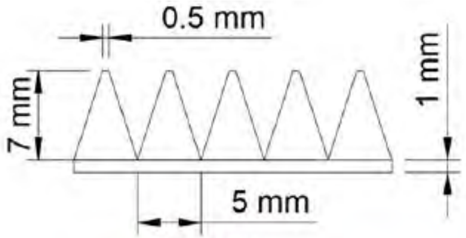




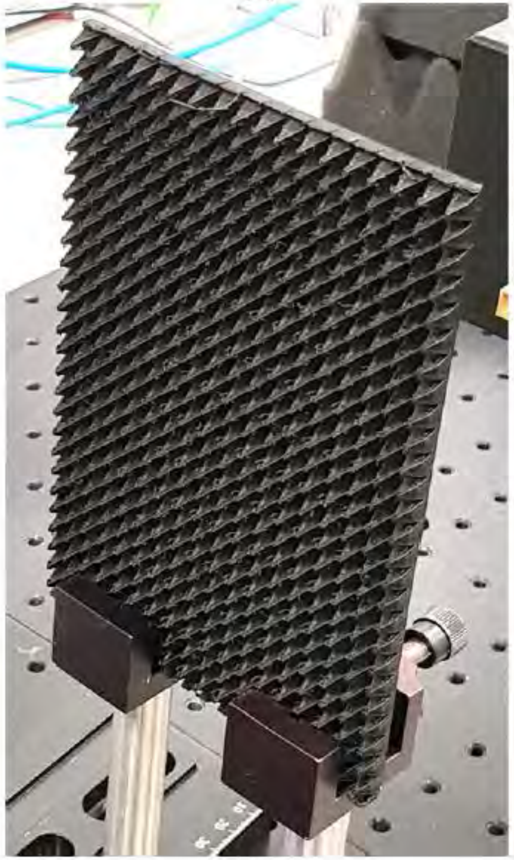


(b) (c)

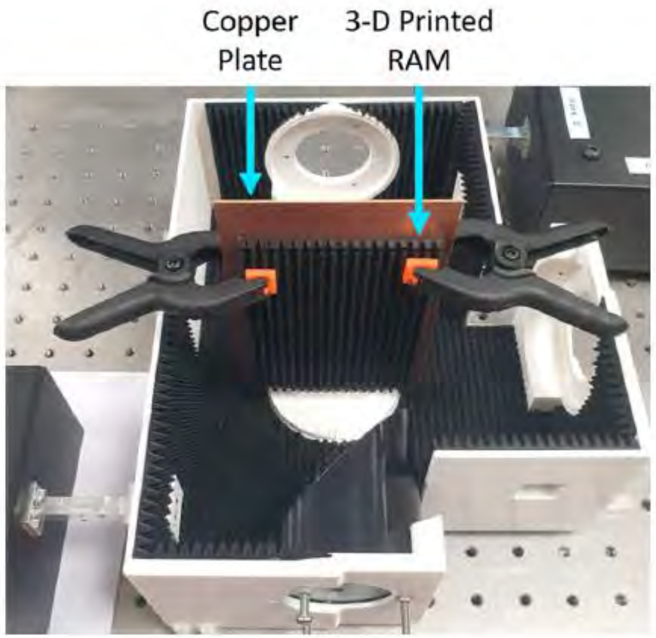
Hyperbolic aspherical plano-convex conventional and Fresnel lenses: optical ray tracing diagram; cross-sectional CAD drawings; photographs.



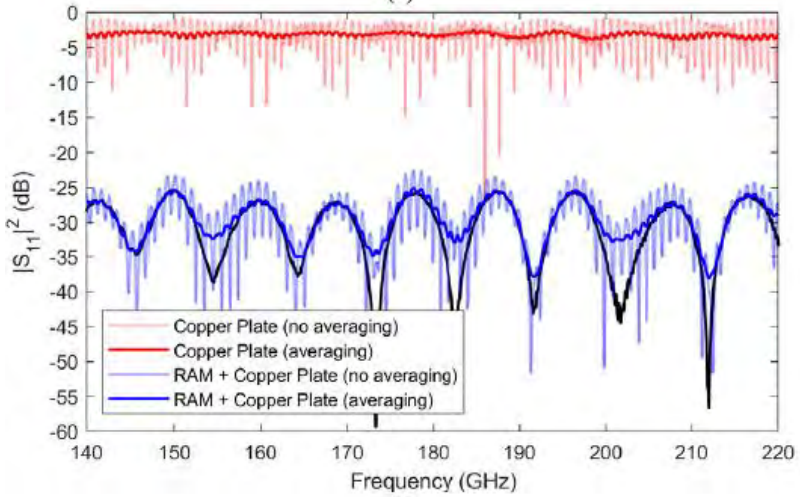
(a)



(b)

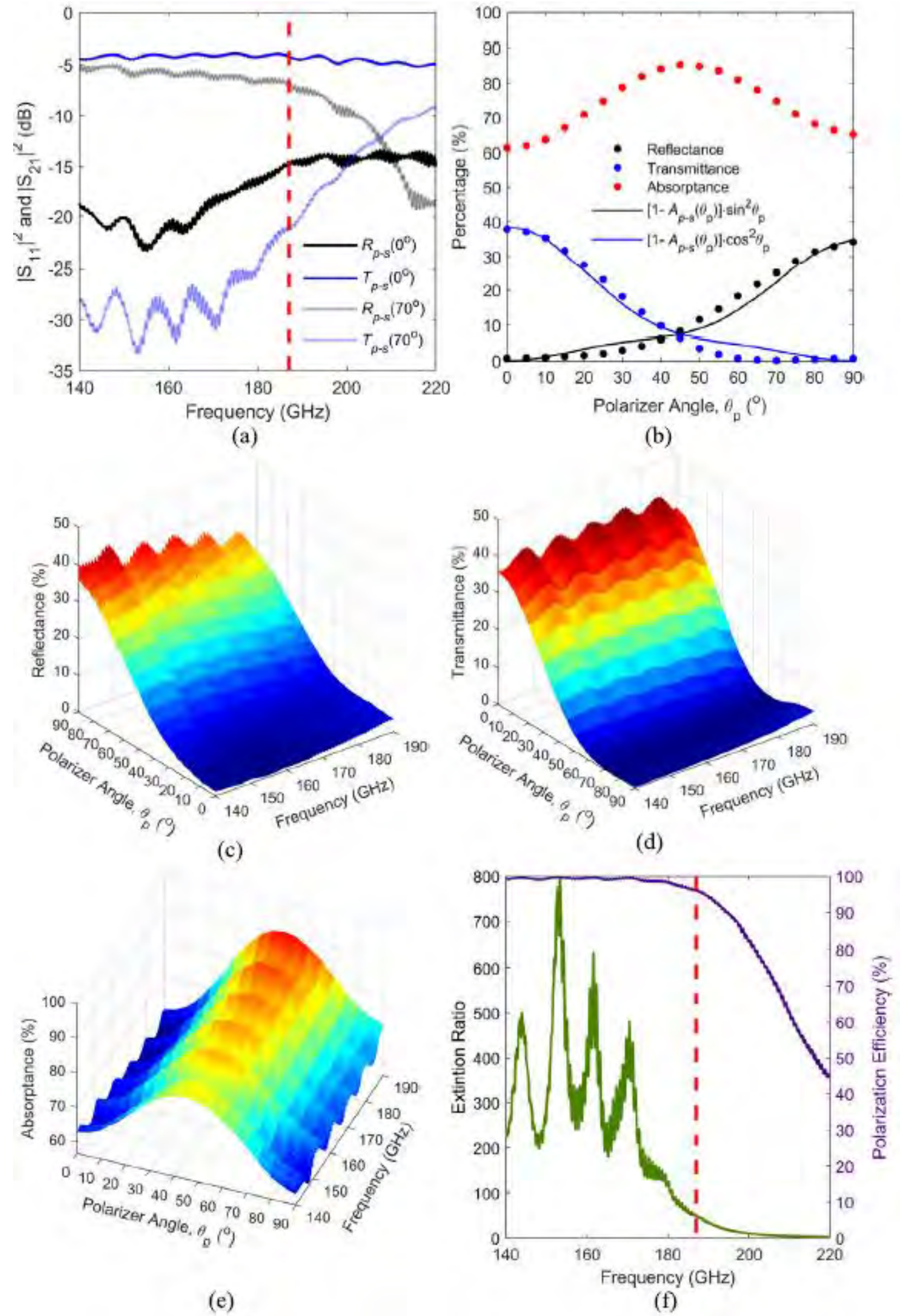


(a)

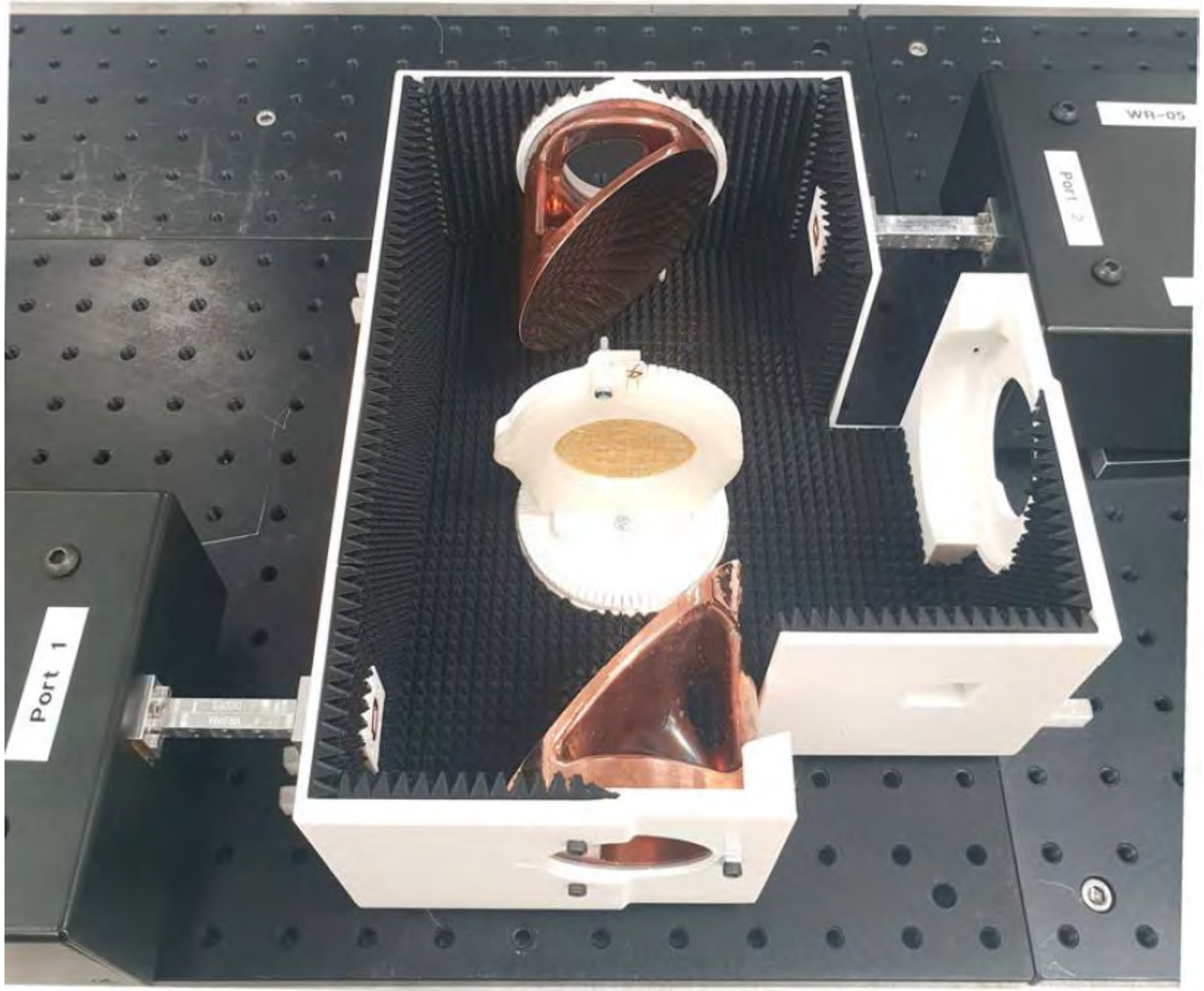


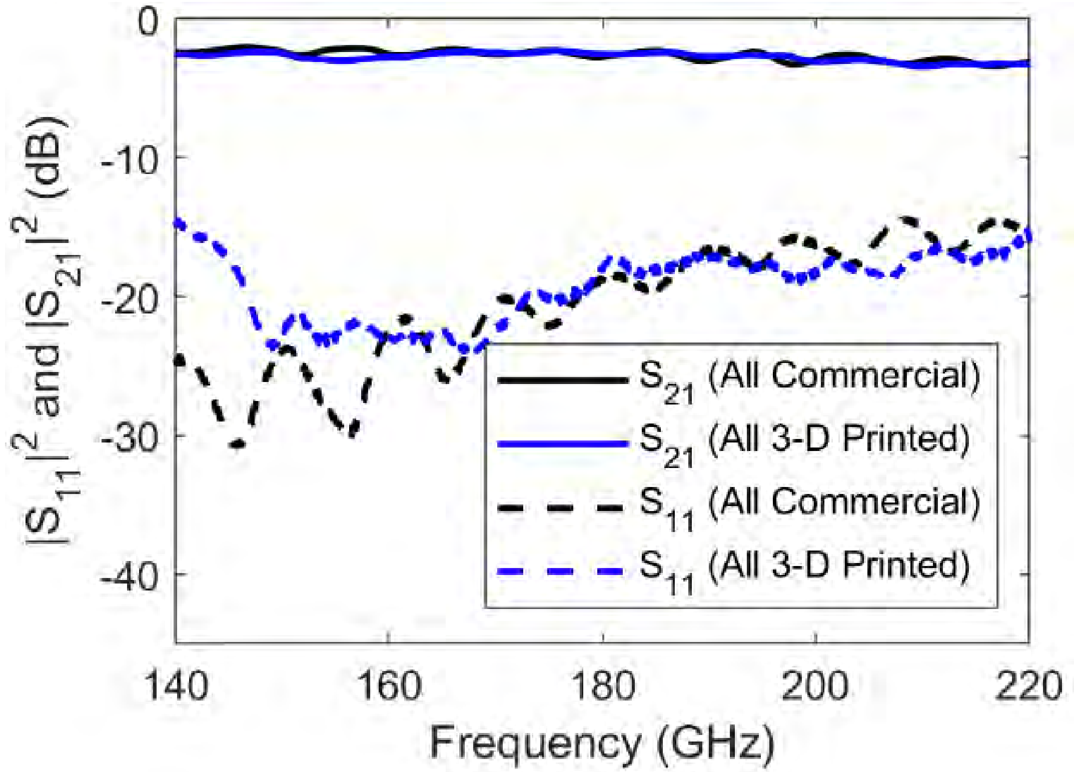
(b)

Measurement of the 3-D printed RAM (with copper back plate) exposed to a collimated beam at normal incidence: (a) test setup with commercial horn and mirror; (b) reflection coefficients (commercial horn measurement shown by the black curve).



3-D printed and gold-leaf gilded grid polarizer: photograph and zoomed-in view photograph (400 μm width and 800 μm separation).





Typical configuration for our 3-D printed quasi-optical housing with HMMH arrangement having the two OAPMs rotated 180^{o} about their common optical axis and the central two-axis rotating platform containing the grid polarizer under test: photograph of the complete integrated subsystem assembly realized using all 3-D printed quasi-optical components (antennas, mirrors, RAM and polarizer).

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Microwave Characterization of Conductive PLA and Its Application to a 12 to 18 GHz 3-D Printed Rotary Vane Attenuator

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SANG-HEE SHIN[2], (Graduate Student Member, IEEE),
ATTIQUE DAWOOD[2], NICK M. RIDLER[3], (Fellow, IEEE),
AND STEPAN LUCYSZYN[2], (Fellow, IEEE)
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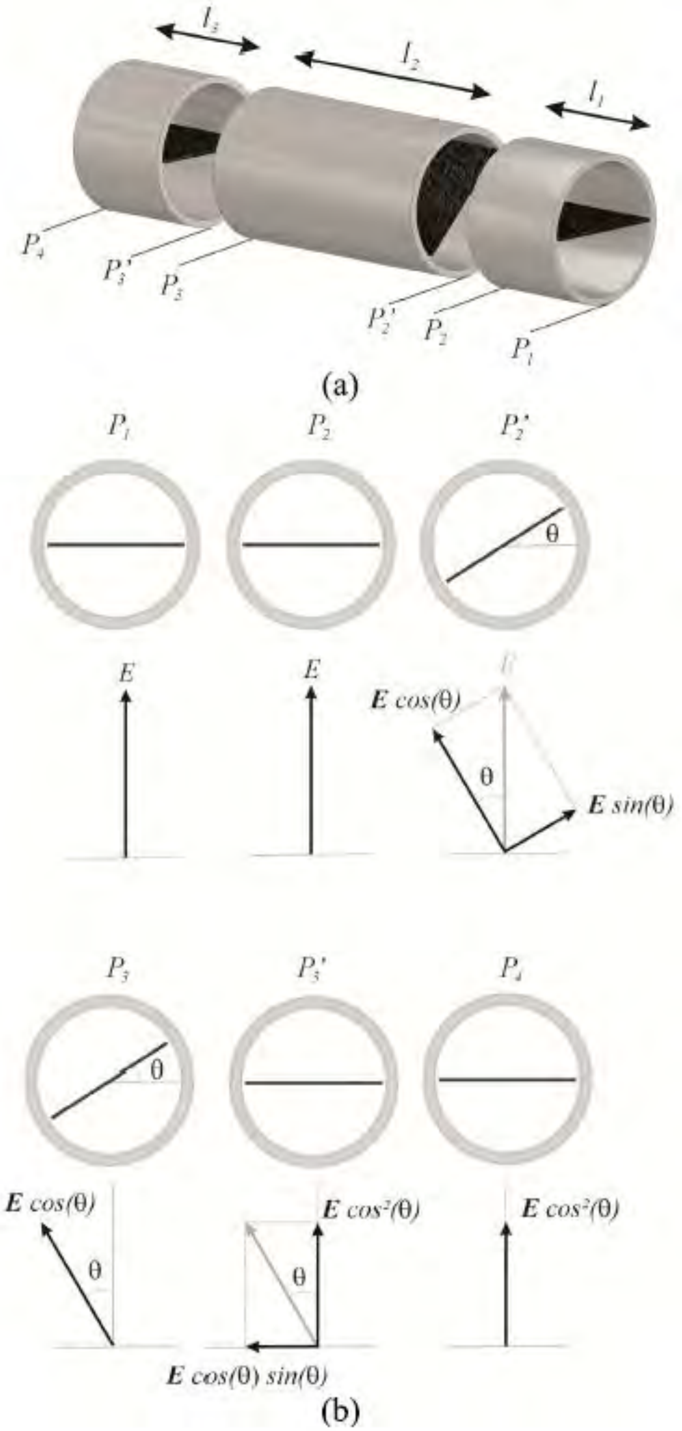
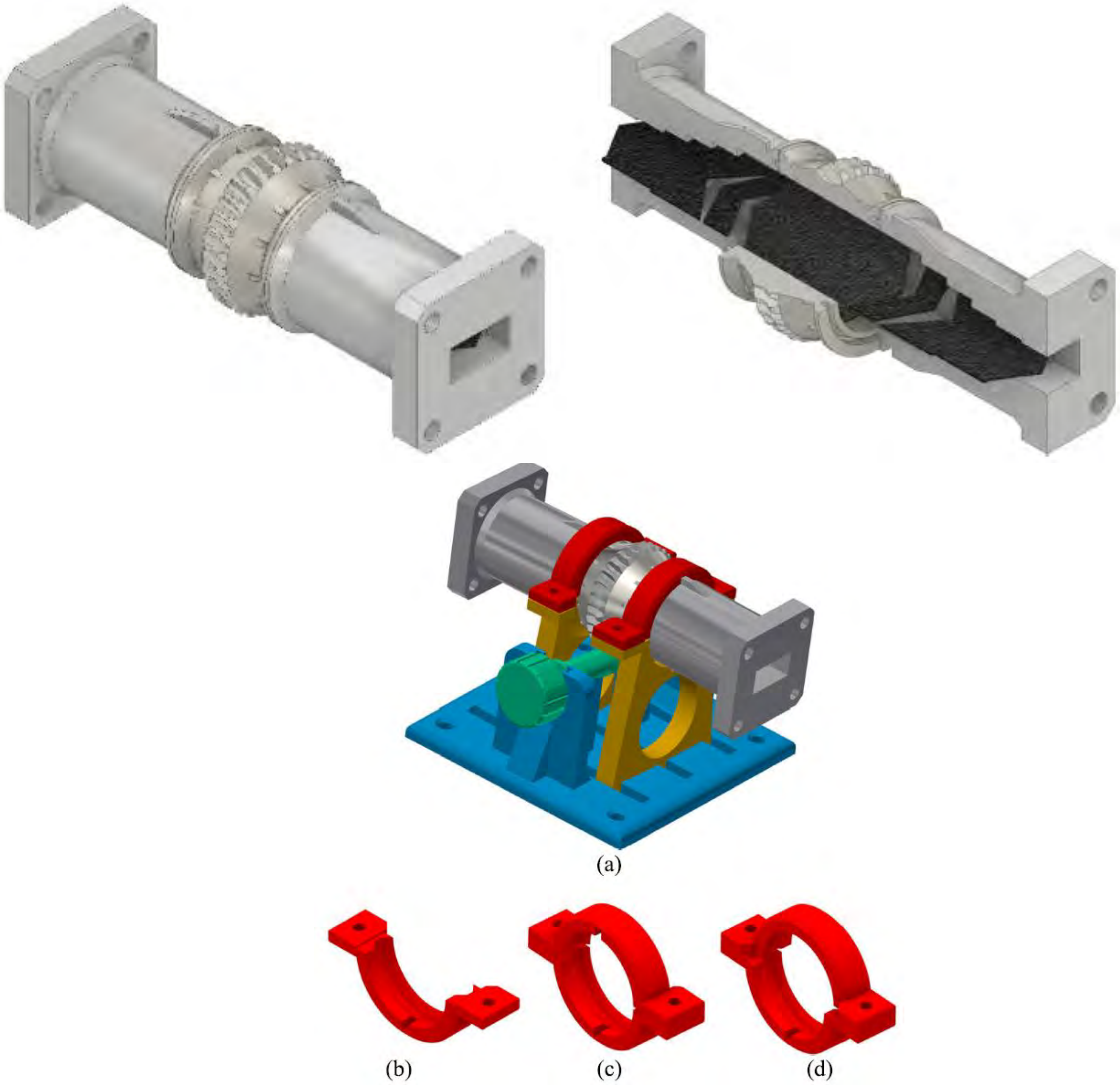
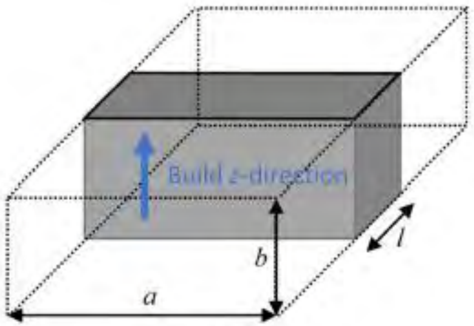
[2]Department of Electrical and Electronic Engineering, Imperial College London, London SW7 2AZ, U.K.
[3]Department of Electromagnetic and Electrochemical Technologies, National Physical Laboratory (NPL), Teddington TW11 0LW, U.K.

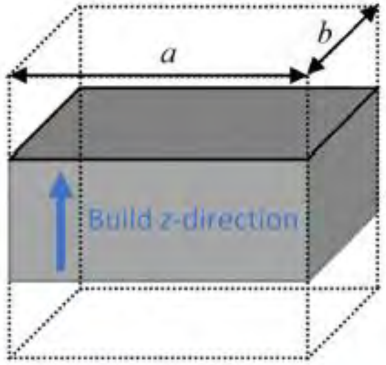




CAD renderings for the three-section waveguide assembly of the rotary vane attenuator, representing a solid silver outer structure (shown in light grey): complete assembly; and cross-section showing absorbers (conductive PLA, shown in black) in the fixed transitions and the rotating center section.

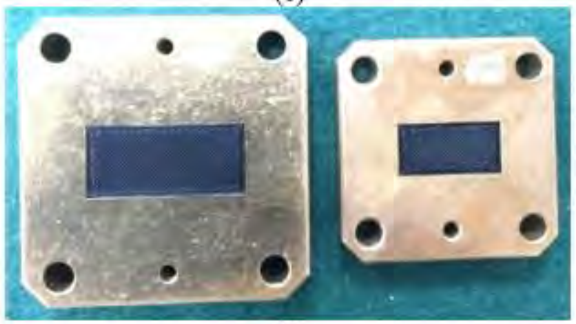


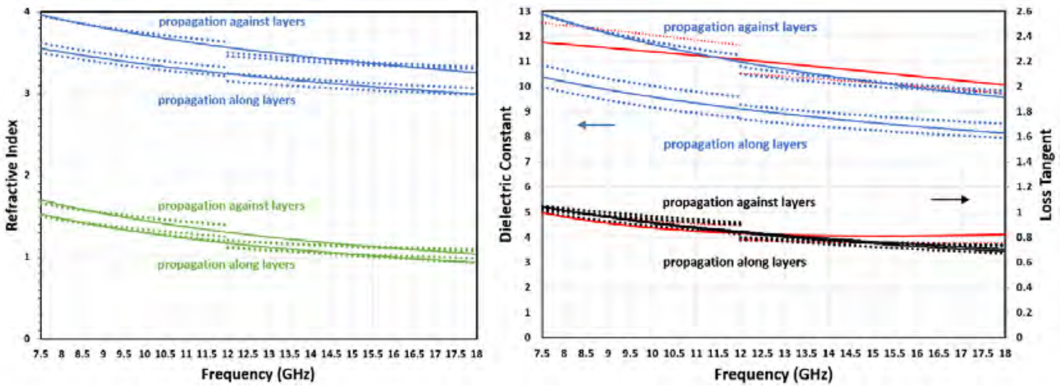
(a)

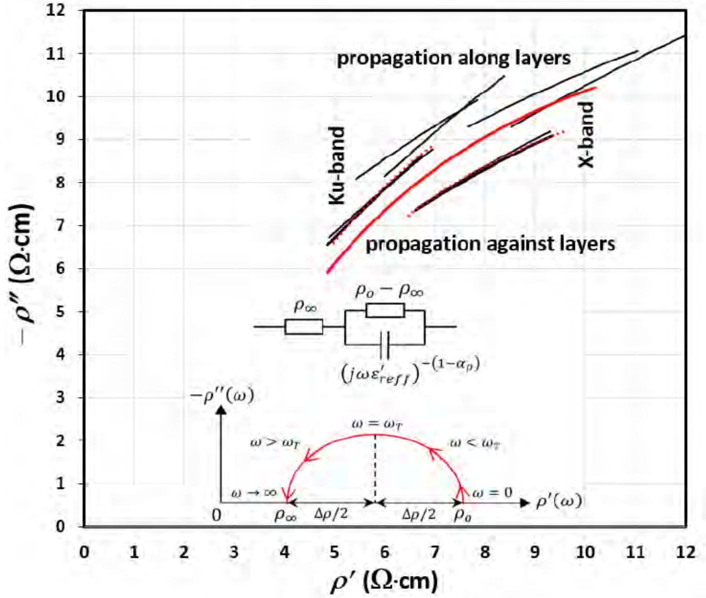


(b)

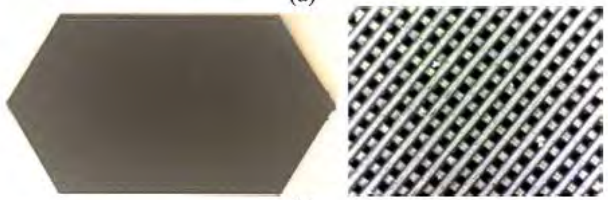

(c)

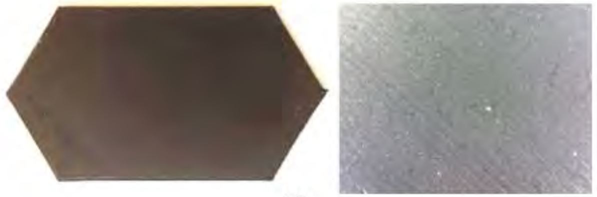

(d)



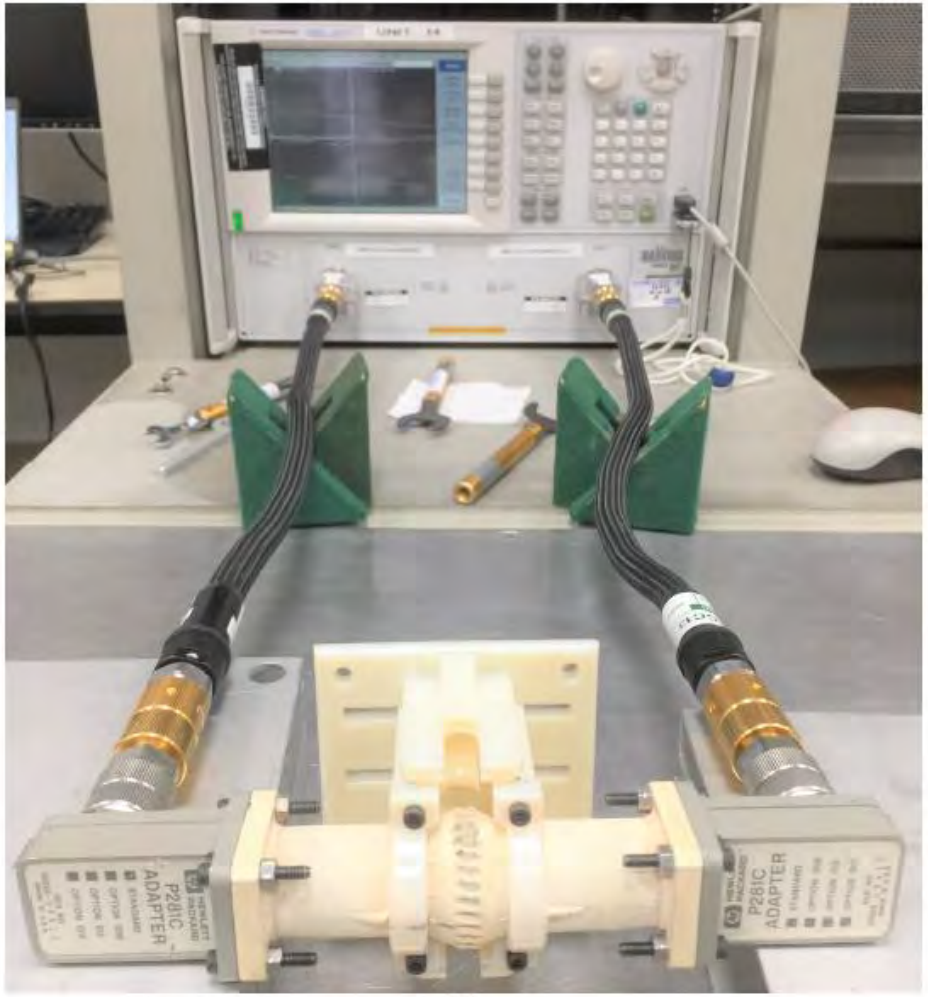



(a)


(b)

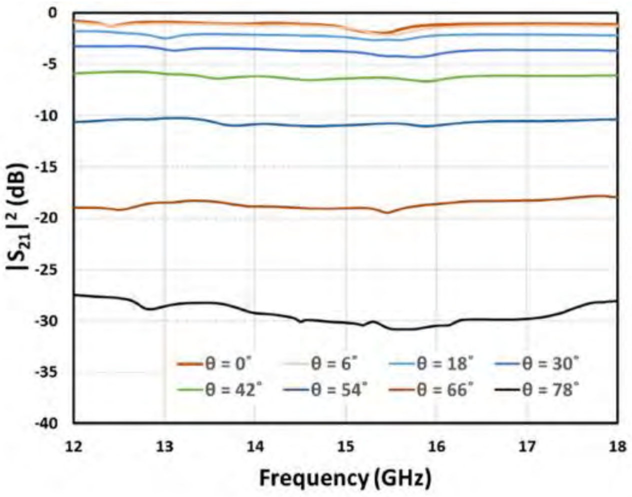

(c)

FDM 3-D printed Proto-pasta conductive PLA cuboid sample pairs: (a) orientation illustration for TE_{10} mode propagation along layers (in the *x*-*y* plane of the build surface); (b) orientation illustration for TE_{10} mode propagation against layers (in the build *z*-direction); (c) photograph of the X-band (left half) and Ku-band (right half) similar sample pairs. TE_{10} mode propagation along layers (top row) and against layers (bottom row). The major divisions on the ruler scales are in units of centimeters; and (d) X-band (left) and Ku-band (right) samples in-situ within MPRWG thru lines with TE_{10} mode propagation against layers.

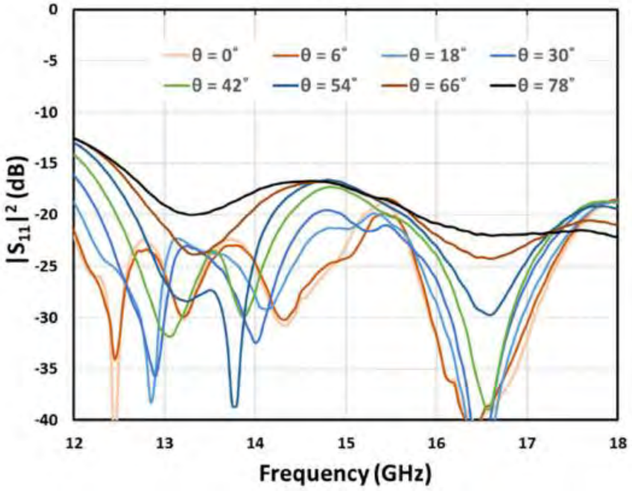


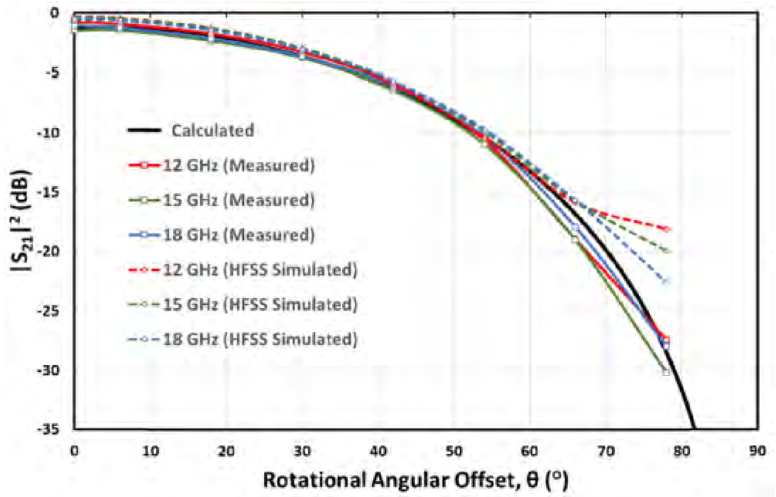
(a)

(b)



(a)





Performance Parameter	This Work (3-D Printed)	Commercial (Machined)
Attenuation Range (dB)	0-27	0-60
Maximum Insertion Loss (dB)	1.2	0.3
Worst-Case Return Loss (dB)	17 (12.7 to 18 GHz)	23
Mass (kg)	0.050	3.4

Measured RVA performance

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Imperial College London

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University of Malaga (Spain)

Xiaobang Shang and Manoj Stanley
National Physical Laboratory

Christopher Brownsword (Technical Director)
UK Centre for Earth Observation Instrumentation

Questions

Lesson from History on Performance Evolution

In 1966, Standard Telecommunication Laboratories showed that the optical fiber losses of 1,000 dB/km in existing glass (compared to 5–10 dB/km in coaxial cable) were due to contaminants that could potentially be removed

In 1970, Corning Glass Works successfully developed optical fibers with attenuation low enough for communication purposes (about 20 dB/km)

https://en.wikipedia.org/wiki/Fiber-optic_communication

In 2017, Sumitomo Electric Industries reported a world record lowest loss of 0.1419 dB/km at 1560 nm

https://global-sei.com/company/press/2017/03/prs029.html

History tells us that you have to start somewhere!