Work Package 3: Enabling Technologies for High-Speed Communications and Remote Sensing

Objectives

1. Developing new concepts and implementations of low-loss millimetre/submillimetre-wave guided-wave structures.
2. Developing design concepts for communication satellite and space-born remote sensing components, suitable for implementation by micromachining technology.
3. Developing new designs of components and systems for high data-rate links between satellites and instruments on board Earth Observation satellites (radiometers, altimeters, and radars) at submillimetre waves, suitable to be manufactured by deep reactive ion-etching (DRIE).
4. Assessing and designing fabrication process flows for manufacturing millimetre-wave and submillimetre-wave devices.
5. Fabricating and measurement of prototypes at millimetre-wave and submillimetre-wave frequencies.

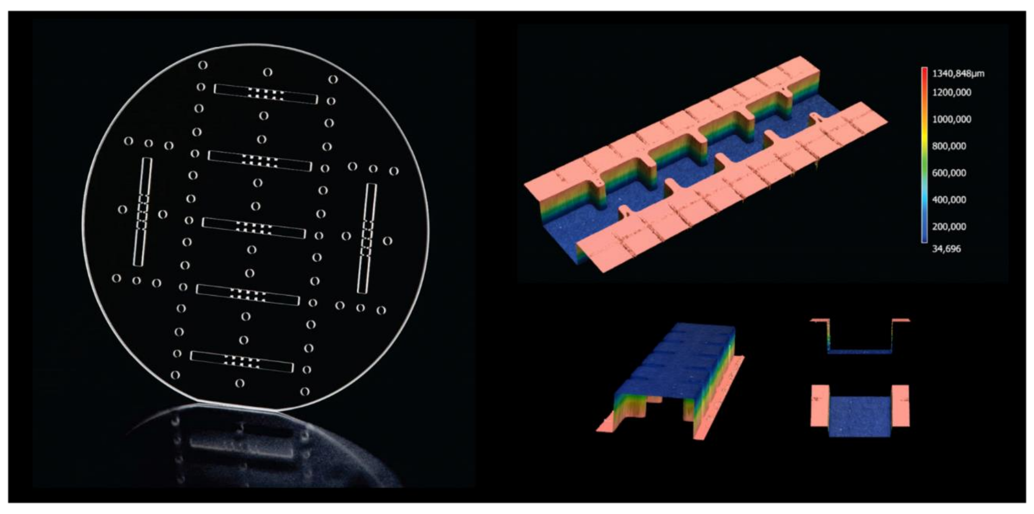
Progress

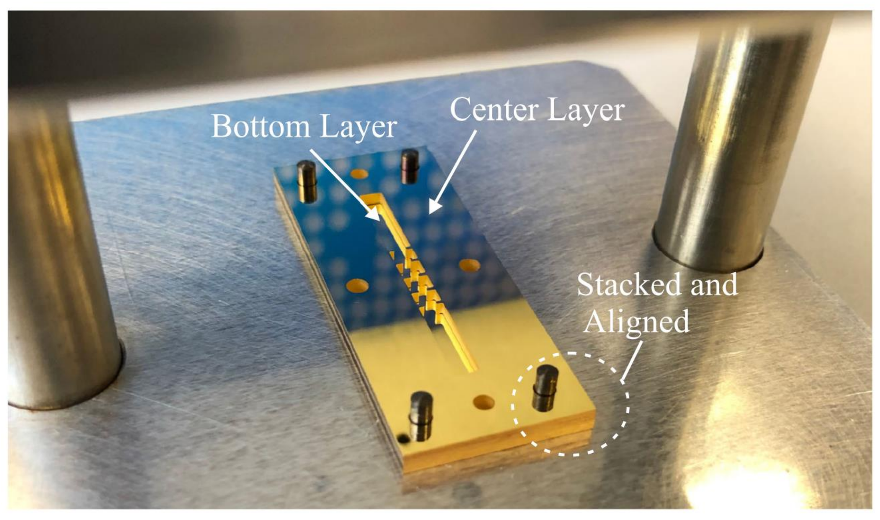
ESR6 Development of Structured-Glass Waveguide Components (SGW)

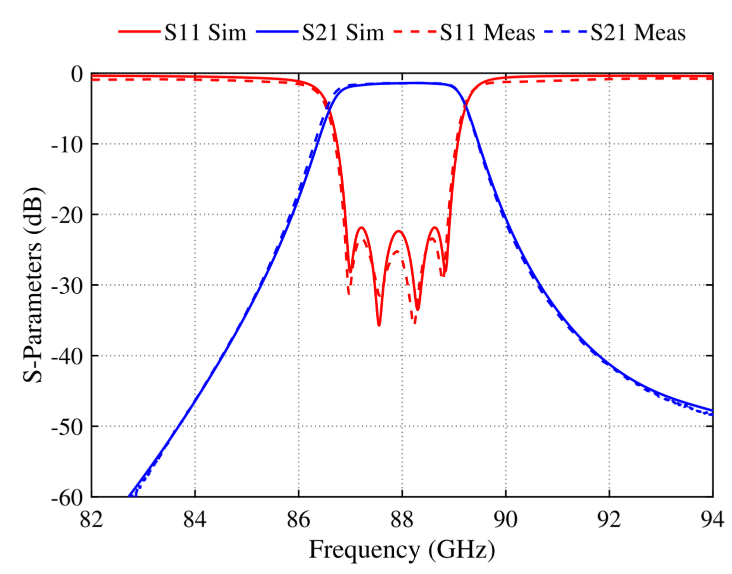
In this work we introduce a high-precision Laser Induced Structured Glass waveguide medium for the design of high-end millimetre-wave components and systems. A fourth-order bandpass filter prototype operating within the W-band frequency range, centered around 88 GHz with a narrow fractional bandwidth of 2.3% is presented in order to validate the technology for accuracy and performance. Most notably: a measured return loss of better than 22 dB and center-frequency offset of approximately 0.117%.

Using the Flexinity process by Schott AG on Borofloat 33 wafers, we can aim for:

- <3 µm Accuracy
- Surface Roughness RA ≈ 250 nm
- Sidewall Roughness RA ≈ 800 nm
- CTE of $3.29 \cdot 10^{-6}$ K^{-1}
- Batch Producible Products
- Eco-friendly Products (no etching with HF)







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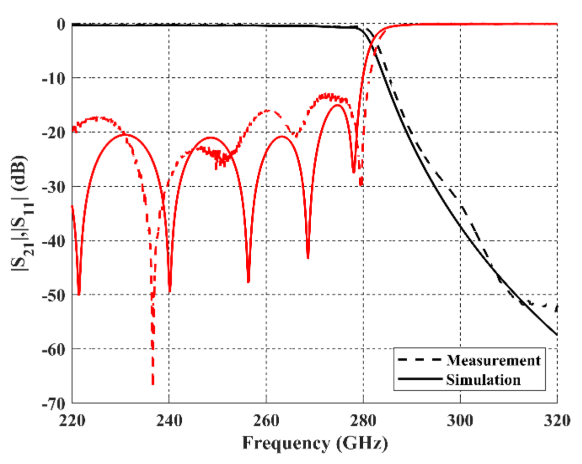
Highly Accurate Results!

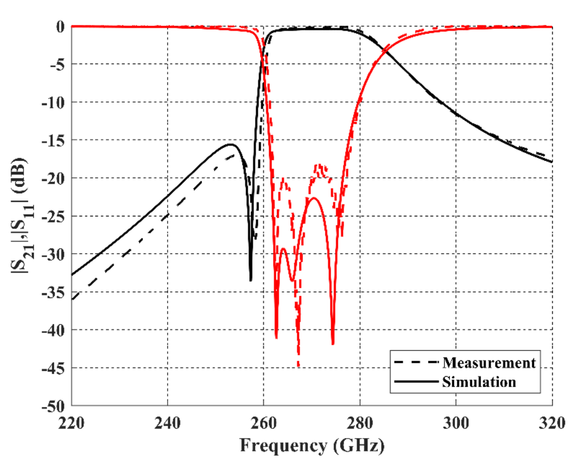
ESR8 Silicon Micromachined Compact High Q-Factor THz Filters

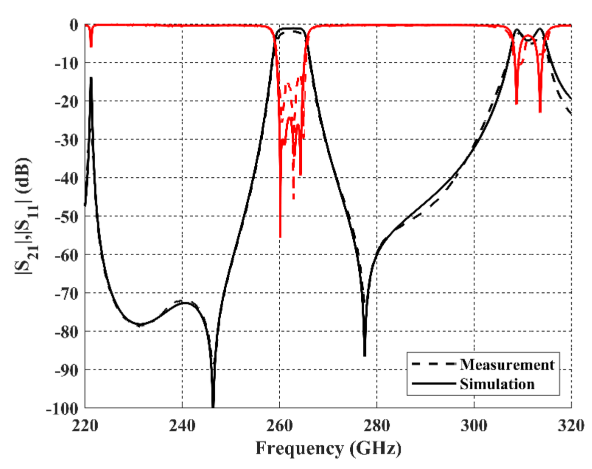
Recent developments in silicon micromachining have resulted in high-performance components operating at frequencies above 100 GHz. Low cost and mass production capabilities make silicon micromachining appealing to a wide variety of applications, including automotive radar, medical imaging, and wireless backhaul.

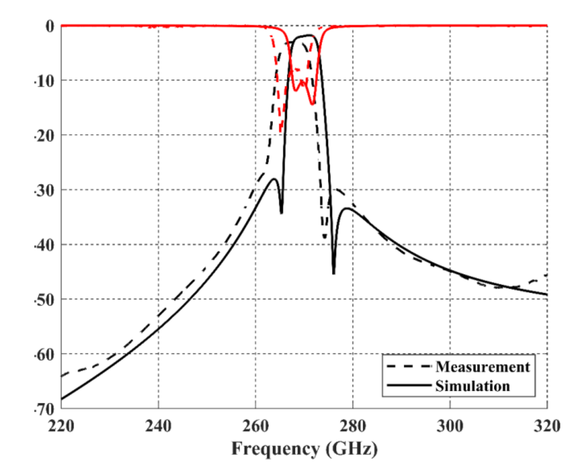
Silicon micromachined filters offer:

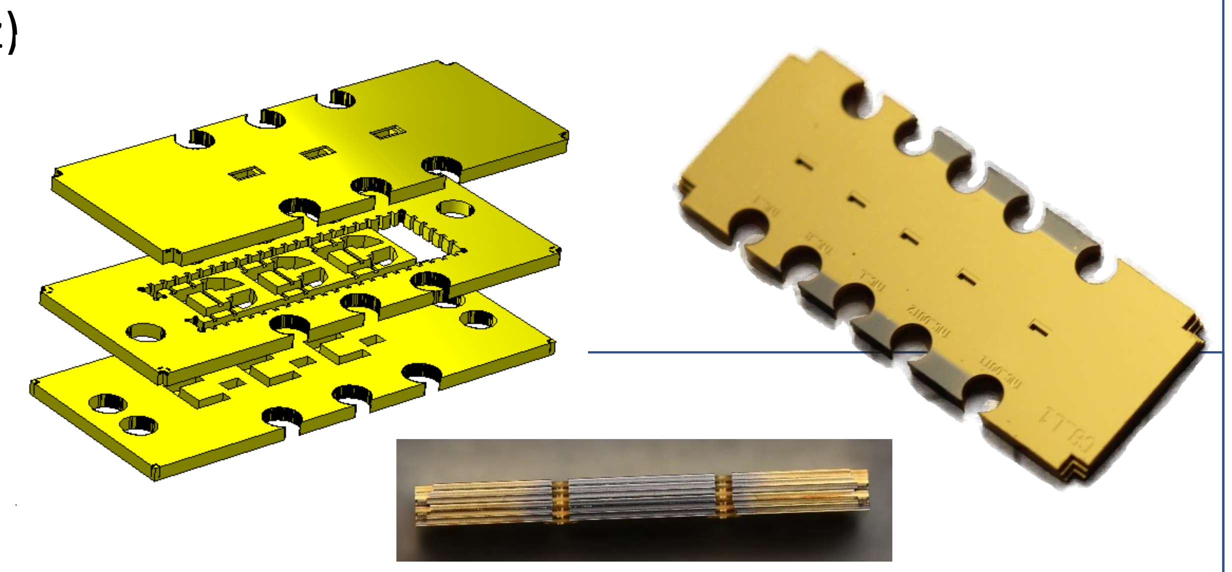
- High performance and robust structures;
- Low-cost waveguide structures;
- Complex micro size geometries with low tolerances (700 GHz filter);
- Smooth surfaces yield low loss structures (unloaded quality factor of 786 at 450 GHz)







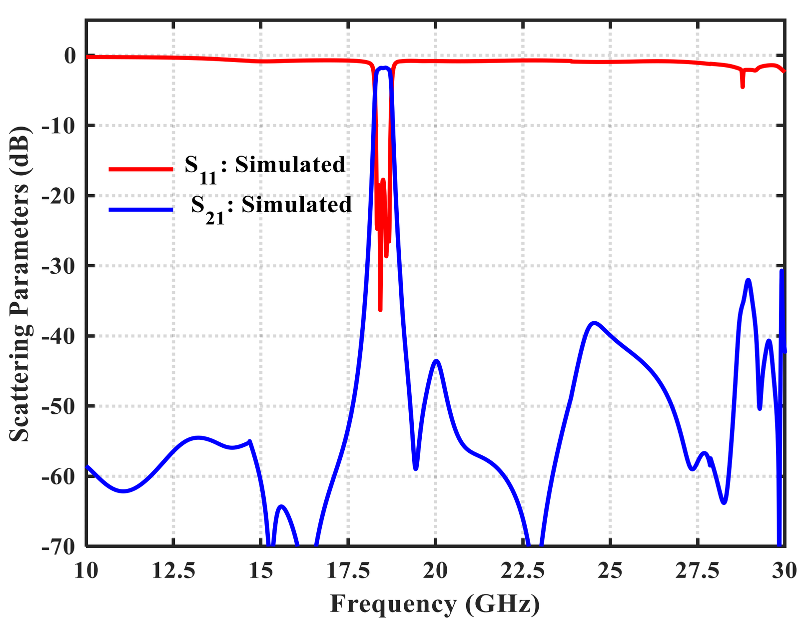


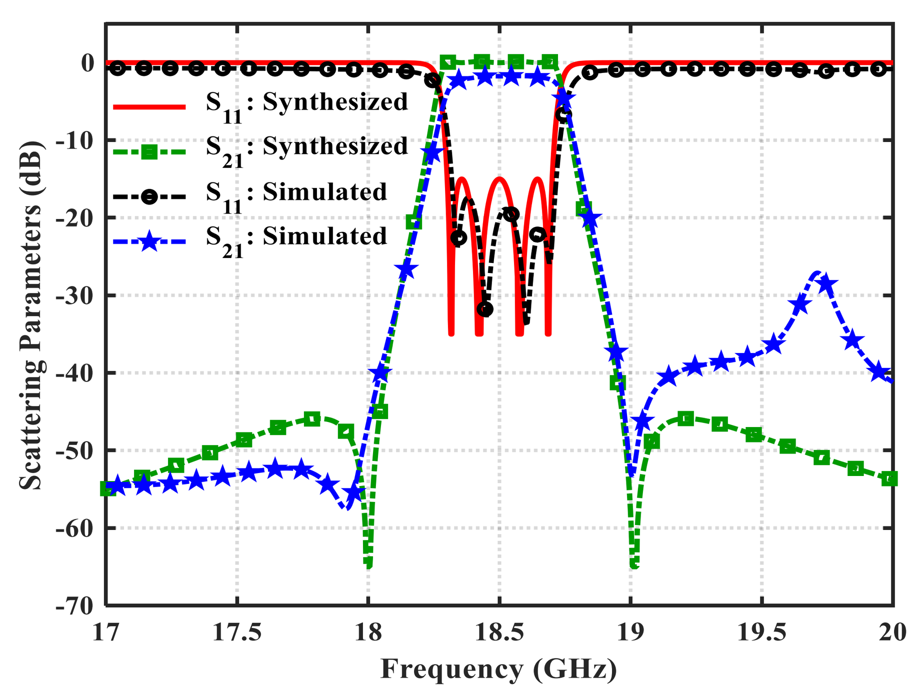


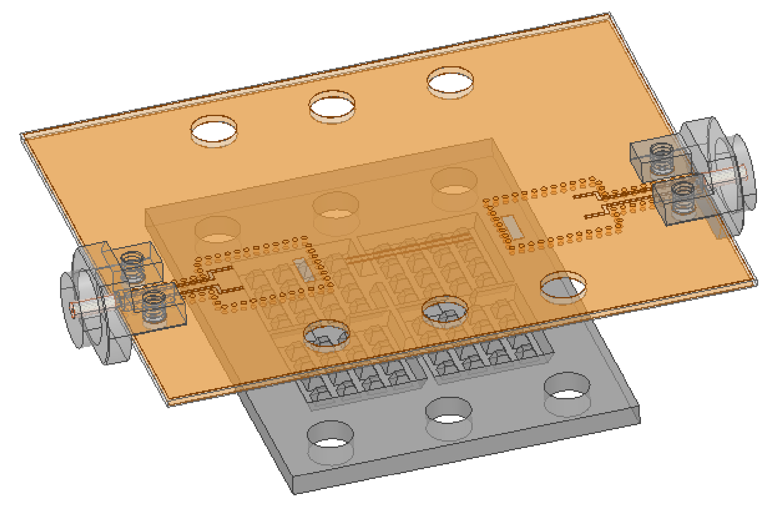
ESR11 Compact Slow-Wave Filters With Double-Sided Selectivity and Out-of-Band Rejection

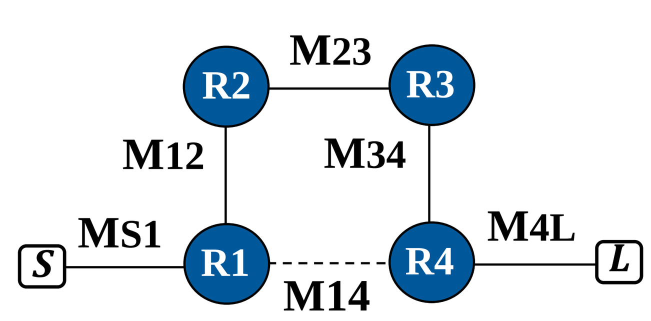
Metasurfaces are a branch of metamaterials that have been widely used in antennas, reflectors, and polarizers. However, their potential to enhance other components' performance might have been overlooked. For example, the frequency selective nature of metasurfaces and the miniaturization effect can create new possibilities in the design of microwave and mm-wave components. Here, we demonstrate a metasurface filter with double-sided selectivity and out-of-band rejection.

- Center frequency: 18.5 GHz
- Bandwidth: 400 MHz
- Insertion Loss: 1.7 dB
- Lower roll-off factor: 13.8 dB/100 MHz
- Upper roll-off factor: 18.9 dB/100 MHz
- Out-of-band rejection: 30 dB up to 30 GHz
- 60% size reduction of each resonator









Advanced Technologies for Future European Satellite Applications

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