Tiny outlines, wide outreach

Precision and complexity are inevitable in the field of microwave technology. Antennas, filters, diplexers, and general miniaturisation of waveguide components help to decisively advance microwave applications in millimetre-wave and even sub-terahertz range. By means of Micro Laser Sintering (MLS), the required components are developed flexibly for the respective application and manufactured on demand. Size and shape are adapted according to the different application areas.

That is what it's all about

The basic function of most waveguide components is to pass on electromagnetic waves of various wavelengths while minimizing the attenuation and distortion.
3D MicroPrint's MLS technology enables monolithic manufacturing of waveguide subsystems that integrate many functions into a single mechanical part. This is highly desirable as it reduces the assembly and the associated risks. A typical application that requires integration of waveguide components are antenna feed-chains in terrestrial and satellite systems that consist of several waveguide parts including polarizers, orthomode transducers (OMTs), filters, bends, and twists. Usually, conventionally manufactured components are used for this purpose, whose complexity is technologically limited, and the manufacturing costs are often correspondingly high due to the required precision. The general merit of functional integration by 3D printing is mass and envelope reduction as well as impeding the generation of passive intermodulation products that could occur when contact flanges are oxidized.

Thinking additive

The ability to produce highly complex waveguides with very low component wall thicknesses and tight tolerances without complicated joining processes are the main disciplines of micro 3D printing. The applications are accordingly diverse: from straight or twisted waveguides, tees, filters and diplexers to septum and horn antennas for the most diverse microwave applications. Compared to other available metal printing technologies the advantages for Micro Laser Sintering are a significantly higher detail resolution for filigree structures as well as the high surface quality right after the manufacturing process which reduces the post processing costs considerably.

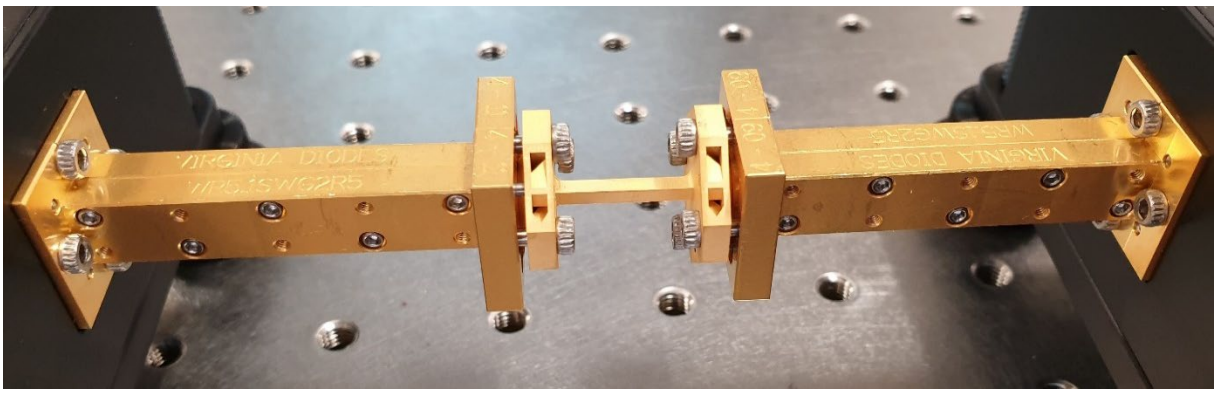

Figure 1 test setup for printed bandpass filter

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The application presented[1] is a monolithically designed bandpass filter for 180GHz G-Band which was printed from stainless steel using Micro Laser Sintering and subsequently coated with Gold to reduce insertion loss to a minimum of 0.5dB. The results demonstrate the capability of the high-precision 3D metal printing technology in fabricating complex geometries that are challenging using conventional milling techniques, as well as an effective plating technique.
The featured parts were manufactured with a DMP Micro Laser Sintering system developed by 3D MicroPrint GmbH.

Figure 2 Cross section

> *"3D MicroPrint has the unique capability of printing 3D metal waveguide devices with high precision down to 5-10 micrometres, excellent consistency/repeatability, and large printing platform up to a few centimetres. This high-precision multi-scale capability is essential for manufacturing millimetre-wave and even sub-terahertz waveguide devices. The capability to produce monolithic part is also highly desirable as it reduces the assembly and the associated risks.*
>
> *Equally importantly, I find the technical support from 3D MicroPrint is superior because of their deep know-how and attention to details."*
> *(Prof. Yi Wang, University of Birmingham, UK)*

The technology

Micro Laser Sintering (MLS) is a powder-based additive manufacturing process for micro parts and components with micro characteristics. Based on digital CAD data, a DMP machine from 3D MicroPrint builds up the workpiece layer by layer without recognizing this on the finished product. Product designers' benefit from newly gained design freedom (unconventionally shaped cavities and inner structures) as additive manufacturing eliminates shape constraints in many areas. Complex structures such as intertwined or interwoven individual parts can thus be manufactured to the highest quality. This tool-free processes enable cost-effective production of single pieces up to individualized series products.

About 3D MicroPrint GmbH

3D MicroPrint GmbH is known for high-precision micro parts manufactured by Micro Laser Sintering. Since the company was founded in 2013 by EOS GmbH and 3D-Micromac AG, the additive manufacturing process has been further developed for micro parts and has been adapted to run an industrial production. Today we are providing our customers the entire portfolio of design consulting for additive manufacturing, feasibility studies and parts production up to their own 3D MicroPrint Micro Laser Sintering system. Furthermore, 3D MicroPrint offers material developments for exclusive technologies on demand. The key applications for micro parts are medical industry, wearables, semiconductors and micro industries, high frequency applications as well as aerospace.

[1]T. Skaik et al., "Evaluation of 3-D Printed Monolithic G-Band Waveguide Components," in IEEE Transactions on Components, Packaging and Manufacturing Technology, vol. 13, no. 2, pp. 240-248, Feb. 2023, doi:10.1109/ TCPMT. 2023.3243002.

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