

# LIGA micro-fabrication of THz components

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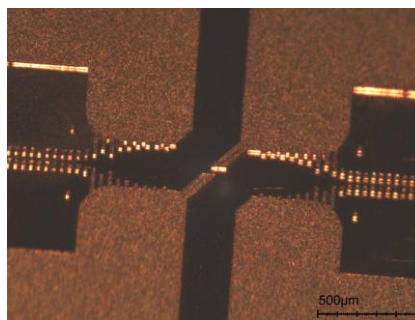
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LIGA (German acronym for **L**ithography, **E**lectroplating, **M**oulding) is a key technology for the micro-fabrication of **H**igh **A**spect **R**atio **M**icro **S**tructures. Structures with heights of a few tens micrometers to a few millimetres with high aspect ratio are fabricated in a wide range of materials like polymers, metals and ceramics. These structures can be made of complex shapes with a sub-micrometer lateral resolution. This technology relies on synchrotron radiation to provide extreme precision and depth of field. LIGA technology at laboratory SOLEIL allowed some accomplishments in THz domain as Slow Wave Structure (fig.1) [1] and multiplexers [2]. Metamaterials (MM) due to their unique possibility of structural design are suitable materials to construct optical devices operating in the THz range with unusual properties as left handed behavior, negative refraction and sub-wavelength focusing. With their potential low losses and isotropic properties, ADMs are considered as an improvement against metallic MMs. Within the TeraMetaDiel project\*, partners intended to design, to fabricate and to characterize All-Dielectric Metamaterials (ADM) which rely on Mie resonances of high permittivity ceramic resonators in the THz range. SrTiO<sub>3</sub> were synthesized as powders and shaped, LIGA technology provided micro-structured tools in order to perform ultrasonic manufacturing to fit a specific gradient in order to ensure the requisite resonances.



*Fig.1. Slow Wave Structure (THz amplifier), copper structures height are 62+-2µm.*

## References

- [1] C. Paoloni, A. Di Carlo, F. Bouamrane, T. Bouvet, A. J. Durand, M. Kotiranta, V. Krozer, S. Megtert, M. Mineo, V. Zhurbenko, *Electron devices, IEEE trans.* **60** (2013) 1236
- [2] V. S. Jagtap, A. F. Dégardin, A. J. Kreisler “*Reflection Phase Gratings: An Elegant Way of THz Beam Multiplexing*” Fall OSA Optics & Photonics Congress, San Jose, USA, 2009.

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