Laser direct writing of high quality cross-shaped terahertz mesh filter

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Cross-shaped mesh terahertz (THz) filters are typically fabricated by either photolithography or metal additive manufacturing. Advantages of these technologies are the high dimensional accuracy of the former and the capability to create complex free form part of the later. Nevertheless, these fabrication approaches have some limitations, e.g. a relatively high processing time, a higher capital investment, a limited thickness in case of photolithography or poor surface integrity and porosity when produced by additive manufacturing. Laser direct writing (LDW) offers a machining solution that can address some of these shortcomings without sacrificing most of their advantages. Also, LDW can fulfil technical requirements associated with the product quality and can be applied on a wide range of materials. These additional advantages can broaden the application area of cross-shaped THz mesh filters.

Intrinsic characteristic of laser micro-structuring is the resulting tapering that impact both achievable geometrical and dimensional accuracy. This is the main challenge in applying LDW for producing such filters. In particular, these process limitations affect the dimensional and geometrical accuracy of their cross-shaped holes and then affects the performance of the mesh THz filters. The research that will be reported investigates a novel fabrication process that addresses the LDW limitations in producing such filters. It employs an ultrafast green laser and a "precess" module [1] for varying the beam incident angle and thus to achieve a zero taper on the side of walls of the filters' cross-shaped holes. In particular, the proposed LDW process improves the ablation efficiency and also the processing consistency along side walls of cross-shaped hole and thus to eliminate the tapering effect. The performance of mesh THz filters produced with the proposed LDW approach is also studied.

[1. ESTIVAL, S., P.-E. MARTIN, and A. Kupisiewicz, *Machining device*. 2019, Google Patents.