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利用形態 : 技術代行
Program Title(English) : Electroplated surface finishing of micromachined filters at 270 GHz
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1. Summary

The sub-THz frequency spectrum (100 GHz-1 THz) is getting increasing attention due to the large available, so far unused spectrum. In particular for telecommunication applications, it is important to create frequency-selective devices (filters), for accessing this frequency range. KTH has developed a micromachined filter technology, which, in terms of Q-factor and insertion loss, is currently world leading. Complex, 4-pole 2 transmission zeros, filter demonstrators have been successfully implemented at 270 GHz, with Q-factors of 800. Prof. Saito at Waseda University is a world-leading expert on electroplating, and electroplated devices done in a previous project for Tokyo Institute of Technology, Prof. Hirokawa, showed outstanding surface quality of gold electroplated silicon chips. KTH therefore approached Prof. Saito for fabricating test samples, and to compare the performance of filters utilizing the gold-electroplating processes at Waseda University. Prof. Saito has completed the fabrication of test samples, which are currently shipped to KTH for assembly and microwave characterization.

2. Experimental

Equipment: Precise Electrodeposition

Several sets of micromachined filters, consisting of three chips each, were fabricated at KTH by deep-reactive-ion etching, and subsequently coated by gold sputtering on a TiW adhesion layer. A schematic drawing of a single chip, containing five filter cavities, is shown in Fig. 1. The chips were handed over to Waseda University for electroplating, which was completed by December 2018. The chips are currently shipped back to KTH and will be

assembled by thermo-compression bonding, and subsequently characterized by 2-port vector network analyzer measurements in the 220-330 GHz frequency band. The performance of the electroplated devices will be compared to devices left at KTH, which are only gold-sputter coated.

3. Results and Discussion

The electroplating process has been successfully completed by Waseda University. Characterization by KTH will be done upon arrival of the chips. It is expected that the RF performance of the devices should improve, due to surface-smoothing effect of the advanced plating process by Waseda University, and due to thicker overall metallization, in particular on the sidewalls. Unloaded Q-factors beyond 1000 at 270 GHz may be expected.

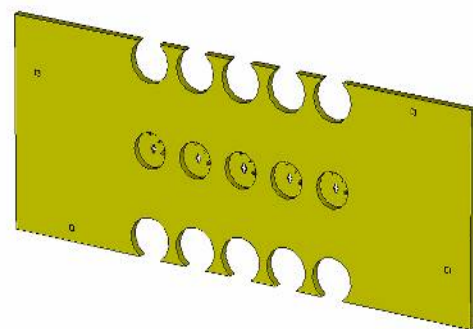


Fig. 1 Schematic drawing of 270 GHz filter cavities, five devices on a single chip.

4. References

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- [2] O. Glubokov, X. Zhao, J. Champion, U. Shah, and J. Oberhammer, "Micromachined Filters at 450 GHz With 1% Fractional Bandwidth and Unloaded Q beyond 700," IEEE Transactions on Terahertz Science and Technology, vol. 9, no. 1, pp. 106-108, Oct. 2019.

5. Publication/Presentation None

6. Patent None