A silicon-based terahertz near-field imaging sensor for ex vivo life-science applications

L. Mavarani[1], P. Hillger[1], J. Grzyb[1], Q. Cassar[2], A. Al-Ibadi[2], T. Zimmer[2], G. MacGrogan[3], J.P. Guillet[2], P. Mounaix[2], U.R. Pfeiffer[1]

[1]*Institute for High-Frequency, and Communication Technology, University of Wuppertal, 42119 Wuppertal Germany*
[2] *University of Bordeaux, IMS UMR CNRS 5218, 33400 Talence, France*
[3]*Institut Bergonié, Centre Régional de Lutte Contre le Cancer, 229 cours de l'Argonne, 33076 Bordeaux, France*

This work shows the advances in the development of a silicon-based terahertz (THz) sub-wavelength imager for tumour margin identification. A fully integrated 0.55 THz near-field sensor implemented in 0.13 µm SiGe HBT technology has been successfully developed [1] and modified [2] by applying a chopping technique resulting in highly improved signal-to-noise-ratio (SNR) (Fig.1). Other than presently available systems based on scanning near-field optical microscopy (SNOM) this sensor could be a possibility to tackle problems like long integration times and sensitivity limitations in these systems [3]. In parallel, using THz Time-Domain-Spectroscopy (TDS) fresh and fixed tissue sections were measured to detect the best suited frequencies for tumour detection. The knowledge of these frequencies combined with the single-pixel near-field sensor could be used for the development of a multi-pixel near-field imager for life-science applications [4].

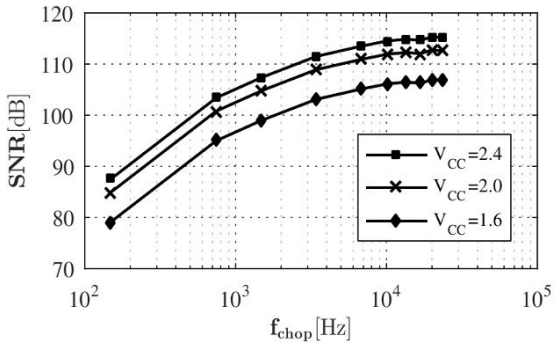

Fig.1. Signal-to-noise ratio of the chopped near-field sensor signal

Funding: This work is part of the project "NearSense- A silicon-based terahertz near-field imaging array for ex vivo life-science applications" and was funded in the frame of the DFG priority program SPP 1857 "ESSENCE" ("Elektromagnetic Sensors for Life Sciences").

References

[1] J. Grzyb, B. Heinemann; U. R. Pfeiffer "A 0.55 THz Near-Field Sensor With a um-Range Lateral Resolution Fully Integrated in 130 nm SiGe BiCMOS" IEEE Journal of Solid-State Circuits, 51(12):3063-3077, December 2016

[2] J. Grzyb, B. Heinemann, and U. R. Pfeiffer, "Solid-state terahertz super-resolution imaging device in 130 nm SiGe BiCMOS technology" IEEE Transactions on Microwave Theory and Techniques, accepted March 2017

[3] F. Shen, Y. Salamin, J. Dong, Y. Sun, J. Huangfu, C. Li, and L. Ran, "Noncontact measurement of complex permittivity based on the principle of mid-range wireless power transfer," IEEE Transactions on Microwave Theory and Techniques, vol. 62, no. 3, pp. 669–678, March 2014.

[4] H. Balacey, B. Recur, J-B Perraud, J. Bou Sleiman, J-P. Guillet, P. Mounaix, "Advanced Processing Sequence for 3-D THz Imaging" IEEE Trans on Terahertz Science and Technology **6**, 2 191, 2016.