20. MICROELECTRONIC SYSTEMS AND INTEGRATED CIRCUITS

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FOCUS OF THE GROUP

- Application of advanced microelectronic technologies to sense, measure, and process physical and biological electrical phenomenon.
- Microwave and Terahertz range sensing and imaging
- Integrated circuit Neural interfaces

The group has a long time experience in deep submicron integrated circuit (IC) design. We conduct research in a field, in which the physical quantities are hardly measurable with off-the-shelf components. Hence, the need for custom designed integrated circuits is unavoidable. Our group is the only academic team in Hungary with daily routine of using advanced IC technologies.

We have participated in several international grants targeting integrated vision systems. One of the most promising directions is the usage of 3D technology to merge image sensing, multi processor image analysis, and high level target recognition and identification in a single IC. The used 3D SOI technology is provided by the MIT Lincoln Laboratory and supported by the Office of Navy Research to form an integrated three layer compact vision system for UAV (unmanned aerial vehicle) surveillance and reconnaissance.

Through cooperation with MTA Research Centre for Natural Sciences and Institute of Microelectronics of Seville, Spain we are developing a complex, multi channel neural sensor interface using very low noise BiCMOS technology. Flexible deep brain electrodes with electrically selectable sensors and integrated amplifiers open new possibilities in understanding low frequency behavior of the brain, long term memory, and adaptation processes.

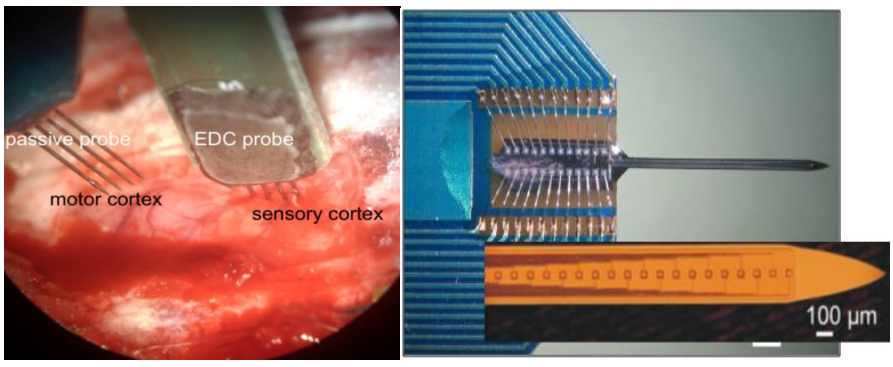

Fig. 1 *Brain electrodes with multiple contacts.*

We also work with very high frequency electromagnetic waves. In the recent decade, the so called Terahertz (>300 GHz) waves come into the center of attention as the last unutilized region of the electromagnetic spectrum. This radiation is not ionizing, hence, in principle does

not harm living tissues, meanwhile provides information of material, moisture, biomarker content undetectable by other non invasive methods. We are a leading group in highly integrated CMOS sub-THz imagers.

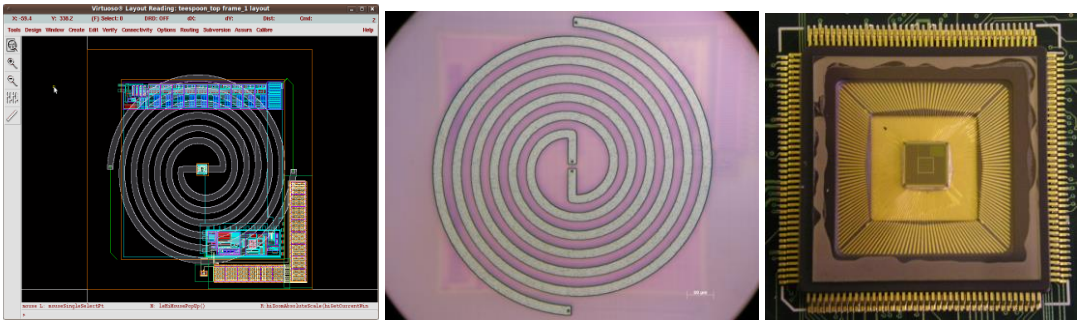

Fig. 2 *Different stages of development of a sub-THz imager: design, microphoto, and complete IC.*

Beside theoretical work and consequent development, we focus as well on real life THz applications, such as skin cancer diagnostics in cooperation with Semmelweis University.

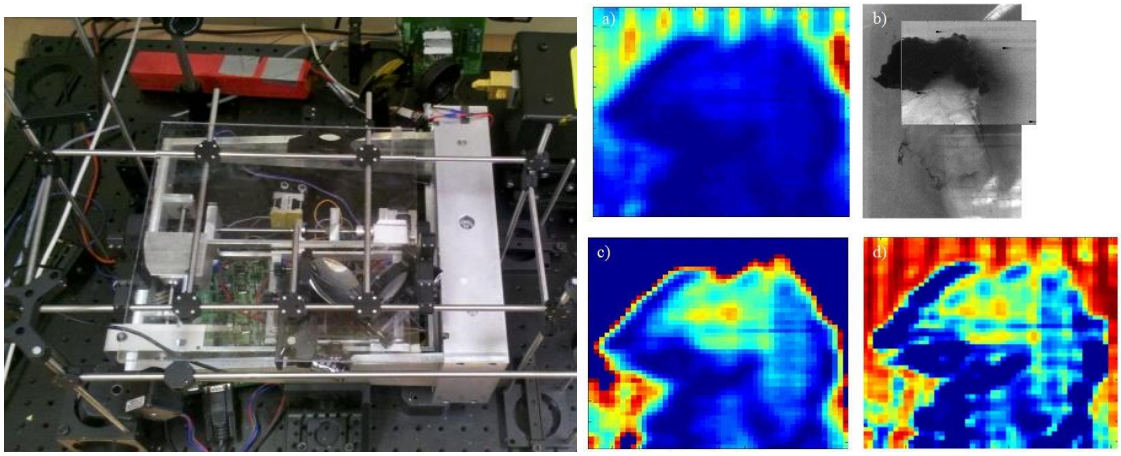

Fig. 3 *Experimental skin scanner and in vitro sample images captured at 460 GHz.*

PUBLICATIONS

[1] P. Földesy. Terahertz single-shot quadrature phase-shifting interferometry, Optics Letters, Vol. 37, Issue 19, pp. 4044-4046, 2012

[2] P. Földesy, Z. Fekete, T. Pardy, D. Gergelyi. Terahertz Spatial Light Modulator with Digital Microfluidic Array, 26th Eurosensors Conference, September 9-12, 2012, Kraków, DOI: 10.1016-j.proeng.2012.09.307

[3] P. Földesy, A. Zarandy. Integrated CMOS sub-THz imager array, 13th International Workshop on Cellular Nanoscale Networks and their Applications (CNNA), pp. 1–4, August 29-31, Turin, Italy, 2012

[4] P. Földesy, Á. Zarándy, Cs. Rekeczky. Configurable 3D-integrated focal-plane cellular sensor–processor array architecture, International Journal of Circuit Theory and Applications, Vol. 36 (5-6), pp. 573-588, 2008

[5] P. Földesy, Á. Zarándy, Cs. Rekeczky, T. Roska. Digital implementation of cellular sensor-computers, International journal of circuit theory and applications, Vol. 34 (4), pp. 409-428, 2006