

Session C2: Sensors**9:00****Cheakamus****Chairs: Fabio Di Francesco, Università di Pisa (fabio.difrancesco@unipi.it)**

9:00 Sigurd Wagner, Princeton University (wagner@princeton.edu)
with T. Moy, Y. Afsar, L. Aygun, Y. Mehlman, J.C. Sturm and N. Verma

Thin-film circuits for interfacing large-area sensor arrays and CMOS circuits

We have been demonstrating sensor systems that combine large-area arrays of sensors, made in thin-film technology, with CMOS ICs [1]. We foresee that such systems will become unobtrusive components of the built environment, with the purpose of augmenting human sensing. Systems for sensing mechanical strain [2], gestures [3], images [4], sound [5], and electrophysiology (EEG) [6] have been demonstrated. Our goals are (i) to understand the optimal distribution of functions between the large-area thin-film and CMOS domains, and (ii) to explore the application space for large-area sensor systems made with this hybrid technology. A priority has been to reduce the number of electrical interfaces between the thin-film and the CMOS domains. Interfaces have been reduced by using purely circuit-based approaches, and also by introducing algorithmic techniques. We will describe several of the thin-film circuits developed for this purpose.

- [1] N. Verma et al., Proc. IEEE 103, 690 (2015).
- [2] B. Glisic et al., Proc. IEEE 104, 1513 (2016).
- [3] Y. Hu et al., IEEE Custom Integrated Circuits Conf., 2014.
- [4] W. Rieutort-Louis et al., IEEE J. Solid-State Circuits 51, 281 (2016).
- [5] J. Sanz-Robinson et al., IEEE JSSC 51, 979 (2016).
- [6] T. Moy et al., IEEE JSSC 52, 309 (2017).

9:20 Lado Filipovic, Technische Universität Wien (filipovic@iue.tuwien.ac.at)

CMOS-compatible semiconductor-based gas sensors

Recently, there has been an ever-increasing demand for functional integration in a single device. Connecting multiple technologies using bond wires can negatively impact performance due to the associated increase in circuit resistances. The highest efficiency is reached when all functionalities are fabricated on a single substrate, deemed System-on-Chip. Fabrication on silicon allows for the efficient integration of sensors and CMOS structures into a truly monolithic device.

The integration of a metal-oxide (MOX) based gas sensing device into silicon technology is a particular challenge. The sensing layer, which can be a nanowire, nanosheet, or a thin film, must be heated to temperatures between 300°C and 500°C to operate as a sensor. For this reason, a microheater is implemented underneath the sensing element. The heater is the main power dissipater and its design determines the total power consumption of the device.

Our work is focused on understanding the consequences of the complex microheater structure on the mechanical stability of the sensor and the optimized operation of the MOX layer. We will describe how the reliability and gas-MOX interaction can be modeled and optimized for low-power operation. Furthermore, we will present some 2D semiconductor alternatives, which go beyond the limitations of MOX-based sensors.