

Device Architectures for Single Walled CNT Sensors and NO₂ Measurement Results

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We report on the concept of applying single walled carbon nanotube field effect transistors (SWNT FETs) as functional building blocks in gas sensors. Advances in the device architecture, fabrication processes as well as better understanding of the behavior of SWNT FETs has enabled the vision of using individual-tube devices directly for NO₂ gas sensors [1]. Significant progress has been made in understanding the sources of drift and hysteresis, and techniques have been introduced to counteract. Reducing the presence of process residues and dielectrics close to the SWNT to the best possible level leads to the suppression of hysteresis and significant improvement in the noise performance [2, 3, 4] as well as improvement in the cross-sensitivity to humidity [5]. Suspended devices are also attractive for self-heated, ultra-low-power architectures [6].

Acknowledgments: Kiran Chikkadi, Matthias Muoth, Wei Liu, Moritz Mattmann, and Lalit Kumar for their contributions to SWNT-FET NO₂ sensors research, Support from ETH Zurich (TH 18/03-1, TH 13/05-3), Swiss National Science Foundation (20021-108059/1 and 200021-153292/1) and KTI/CTI (8885.2 PFDP-NM) is gratefully acknowledged.

- [1] Christofer Hierold, Alain Jungen, Christoph Stampfer, Thomas Helbling, *Sensors and Actuators A* **136**, 51 (2007).
- [2] Kiran Chikkadi, Matthias Muoth, Cosmin Roman, Miroslav Haluska and Christofer Hierold, *Beilstein J. Nanotechnol* **5**, 2179 (2014).
- [3] Kiran Chikkadi, Matthias Muoth, Wei Liu, Verena Maiwald, Christofer Hierold, *Sensors and Actuators B: Chemical* **196**, 682 (2014).
- [4] Wei Liu, Kiran Chikkadi, Shih-Wei Lee, Christofer Hierold, Miroslav Haluska, *Sensors and Actuators B: Chemical* **198**, 479 (2014).
- [5] Jaap M. H. Kroes, Fabio Pietrucci, Kiran Chikkadi, Cosmin Roman, Christofer Hierold, Wanda Andreoni, *APPLIED PHYSICS LETTERS* **108**, 033111 (2016).
- [6] Kiran Chikkadi, Matthias Muoth, Verena Maiwald, Cosmin Roman, and Christofer Hierold, *APPLIED PHYSICS LETTERS* **103**, 223109 (2013).