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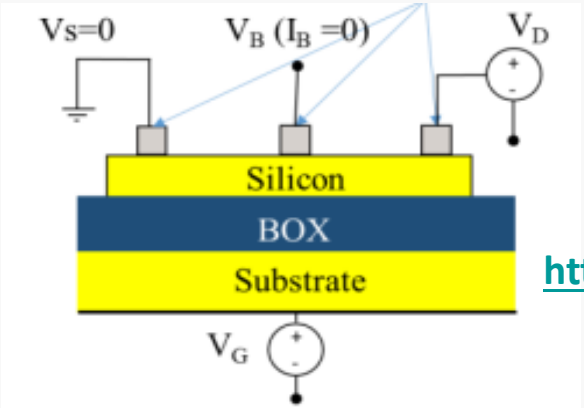
The out-of-equilibrium body potential as new detection paradigm for bio-chemical sensing with metal contact SOI devices



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Abstract

FET sensors were discovered on 1970 with the introduction of the Ion Sensitive Field Effect Transistor (ISFET) [1]. Since then, there is a continuous interest on such devices due to their appealing properties such as CMOS compatibility and light weight that allow for portable sensing applications. Despite the wide range of architectures and materials proposed as variations to the standard ISFET, the sensors mainly measure a current variation or a shift in the current characteristics. A novel detection method, the out-of-equilibrium body potential reading, is presented as an alternative to the classic current measurements. This dynamic potential variation was firstly observed in fully depleted (FD) Silicon-On-Insulator (SOI) Metal-Oxide-Semiconductor (MOS)FETs; it was initially used in memory applications [2] and in 2018 was successfully used for detection of gold nanoparticles in “dry-conditions” [3]. In the first part of this seminar, we will briefly present the bio-chemical FET sensors, explain their basic components and operation principle. To examine the new sensing capabilities of the out-of-equilibrium body potential, SOI devices with metal contacts in which the phenomenon occurs are required. Thus, in the second part of the seminar, we will focus mainly on the technological advancements concerning the semiconductor sensing element (device fabrication, detection set-up) and measurement conditions along with the necessary theoretical establishment that supports them. Finally, we will present the proof-of-concept of “in-liquid” sensing with the out-of-equilibrium body potential.

[1] P. Bergveld, IEEE Transactions on Biomedical Engineering BME-17 (1970) 70–71
[2] M. Bawedin, S. Cristoloveanu, D. Flandre, F. Udrea, Solid-State, Electronics 54 (2010) 104–114
[3] L. Benea, M. Bawedin, C. Delacour, I. Ionica, Solid-State Electronics 143 (2018) 69–76.