



**HAL**  
open science

## **Integration of Smart Sensors on CMOS technologies for real time environmental quality monitoring**

A Souifi, A Ghouma, S Cavalaglio, B Vilquin, A Assaf, T Fiorido, M Bendahan, B Salem, T Baron, S Monfray

### ► **To cite this version:**

A Souifi, A Ghouma, S Cavalaglio, B Vilquin, A Assaf, et al.. Integration of Smart Sensors on CMOS technologies for real time environmental quality monitoring. Chemistry of Nano and Biosystems: From Research to Applications, Fondation Alexander-von-Humboldt - Maghreb-Alexander von Humboldt Alumni Association, May 2024, Alger, Algeria. <hal-04912841>

**HAL Id: hal-04912841**

**<https://hal.science/hal-04912841v1>**

Submitted on 30 Jan 2025

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



HAL Authorization



UNTERSTÜTZT VON / SUPPORTED BY

Alexander von  
**HUMBOLDT**  
STIFTUNG



Chemistry of Nano and Biosystems  
From Research to Applications  
Algiers 20-22, 2024



# Integration of Smart Sensors on CMOS technologies for real time environmental quality monitoring

A. Souifi<sup>1,2</sup>, A. Ghouma<sup>1</sup>, S. Cavalaglio<sup>1</sup>, B. Vilquin<sup>3</sup>, A. Assaf<sup>1,3</sup>, T. Fiorido<sup>4</sup>, M. Bendahan<sup>4</sup>, B. Salem<sup>1</sup>, T. Baron<sup>1</sup> and S. Monfray<sup>5</sup>

<sup>1</sup>Laboratoire des Technologies de la Microélectronique, UGA, CNRS, Grenoble, France

<sup>2</sup>Laboratoire Ampère, Université de Lyon, CNRS, INSA, ECL, UCBL, Ecully, France,

<sup>3</sup>Institut des Nanotechnologies de Lyon, Université de Lyon, CNRS, INSA, ECL, UCBL, Ecully, France

<sup>4</sup>Aix Marseille Univ, Université de Toulon, CNRS, Marseille, France,

<sup>5</sup>STMicroelectronics, 850 Rue Jean Monnet, Crolles, France.

Contact: [abdelkader.souifi@insa-lyon.fr](mailto:abdelkader.souifi@insa-lyon.fr)

**Key words:** Chemical Sensors, CMOS, IoT, Environmental sensing

## Abstract :

Smart Sensors are crucial technological building blocks for a wide range of applications including information technologies, automotive, industrial systems, health monitoring and environmental quality monitoring. In the context of Internet of Things (IoT), ultra-low-power sensors integrated on CMOS is an interesting option for Wireless Sensor Nodes (WSN) for real-time environmental quality monitoring [1], [2].

In this talk, we present the interest of Fully Depleted Silicon On Insulator (FDSOI) technologies for sensing applications. After a description of pH sensors (ISFETs) integrated on industrial 28 nm FDSOI CMOS platform using ALD deposited aluminum oxide as sensing layers [3], we will present recent advances on sensing materials for environmental sensors for air and water quality monitoring. For air quality monitoring, we present sensing properties at very low temperatures (< 50 °C) of metal oxides (SnO<sub>2</sub>) and hybrid polymers (PEI + SiO<sub>2</sub> NPs) for NO<sub>2</sub> and CO<sub>2</sub> detection respectively. For water quality monitoring we present a technological approach for the fabrication of ion sensing membranes (ISM) selective to nitrates (NO<sub>3</sub><sup>-</sup>) ions polluting ionic species.

## **References:**

- [1] J.K. Hart et al. Environmental sensor network: a revolution in the earth system science? Earth Sci. Rev., 2006
- [2] P. Burkhardt-Holm « Linking Water Quality to Human Health and Environment: The Fate of Micropollutants. Working Paper Series, No. IWP/WP/3/2011.
- [3] G. T. Ayele, et al. « Ultrahigh-Sensitive CMOS pH Sensor on 28 nm FDSOI », IEEE-JEDS, 2018, J-EDS, 2018