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## Microelectronics Department Half-Day Seminar

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# Microelectronics Department Half-Day Seminar

26 November 2019, Bat 4, Salle de Séminaire

## 09:30 - 10:30 Approaches to TCAD Modeling for Nanoscaled Devices

**Abstract:** Technology Computer Aided Design (TCAD) simulation tools are finite-element based programs which have promoted the development of bulk Silicon technology, by 1) exploring new device concepts, 2) providing physical insight of experimental data, and 3) allowing for sensitivity study of device characteristics. However, in the recent years the shrinkage of the sizes has been rapidly taking the MOSFET to its physical limit, where quantum effects have to be taken into account. To push MOSFETs to their limits and to explore devices that may complement or supersede them, calibrated and trustworthy TCAD simulations of these devices are indispensable in order to fully assess their benefits and limitations. In this talk, two case studies will be examined, dealing with different aspects of TCAD modeling of nanoscaled devices

**Speaker:** **Dr. Stefania Carapezzi**, *Advanced Research Center on Electronic System - University of Bologna, Viale Risorgimento 2, Bologna, Italy*. Her research is focused on implementing TCAD models for MOSFET architectures where quantum effects are not negligible. In particular, her work has dealt with 1) quasi-ballistic effects in short channel double-gate III-V MOSFETs, 2) mobility of strained In<sub>0.53</sub>Ga<sub>0.47</sub>As channel ultra-thin-body double gate MOSFETs, 3) self-heating effects in carbon nanotube FETs. Dr. Carapezzi has obtained her PhD at the Department of Physics, University of Bologna, in 2014.

## 10:30 – 11:30 Nanomaterials for Sensing and Mechanical Energy Harvesting: Towards Autonomous Wearable Sensors

**Abstract:** Wearable systems and flexible electronics have gained significant interest recently because of the wide range of applications they enable which includes health monitoring through tattoo-like sensory skin patches, foldable displays or communication devices, and tactile skin in robotics or prosthetics, etc. The reliable real-time operation of myriad sensors and electronics on such systems pretty much depend on the energy, which is currently supplied through conventional batteries having drawbacks such as bulky, non-flexible, limited lifespan, chemical hazard, and the periodic replacement etc. For wearable systems to be effective enabler of an application, especially where portability is necessary, energy autonomy is critical. The present talk delivers the concept of low-temperature processable organic / inorganic hybrid systems for the realization of inexpensive electronic devices including field-effect transistors (FETs), piezoelectric nanogenerators (PENGs), and resistive sensors on various polymeric substrates such as polyethylene terephthalate (PET), Polydimethylsiloxane (PDMS), etc. The developed devices will contribute in designing next-generation of wearable smart sensing systems to accurately collect data from the human body which relates to the individual's specific health conditions.

**Speaker:** **Dr. Abhishek S. Dahiya**, *IES, University of Montpellier, CNRS, Montpellier, France*. Dr. Dahiya received his Master in Technology in nanoscience and nanotechnology from GGS Indraprastha University (India) in 2011 and the Ph.D. degree in Electronics (ZnO nanostructures for electronic and energy harvesting applications) from the GREMAN laboratory, Université François Rabelais de Tours, France in 2016. He performed his postdoctoral work at the GREMAN laboratory from 2016 to 2017 and the University of Bordeaux (ICMCB lab), between 2018 and 2019. Currently, he is working as a postdoctoral researcher at the IES-CNRS/Université de Montpellier in France. His research focus on the synthesis of metal oxide nanostructures and fabrication of nanodevices such as field-effect transistors, source gated transistors, mechanical and gas sensors, and piezoelectric energy harvesters.

## 11:30 - 12:30 Carbon Nanotube Yarn Electrical Transport Study from Experiments to Semi-Empirical Modeling

**Abstract:** This work aims to develop new materials to replace metals in electrical wiring. Carbon nanotubes (CNT) are a good alternative as they show a high electrical conductivity as well as they can be assembled into yarns. However, CNT yarns have not yet reached the electrical conductivity of individual CNTs preventing them from competing with metals. All the published works on CNT yarns spun from CNT arrays reveal that their resistivities are limited above 1 mΩ.cm. In order to understand this apparent limitation, we present an extensive study of the CNT yarn electrical transport by measuring the yarn resistance from 3 K to 300 K. We show that the CNT yarn electrical transport is dominated by the CNT-CNT contact resistance below 70 K and by the intrinsic CNT resistance above. The CNT yarn electrical conductivity was improved by improving the CNT structural quality and by doping. The CNT structural quality improvement allows reaching a resistivity record of 0.76 mΩ.cm. From all our experimental studies and the literature data analysis, we developed a new electrical transport model that perfectly fits resistance from 3 K to 300 K for every CNT materials. At very low temperature, the transport follows the Luttinger Liquid theory whereas at higher temperature it depends on both the intrinsic CNT wall electrical transport (metallic or semi-conducting) and the CNT arrangement (bundled or individualized).

**Speaker:** **Dr. Yoann Dini**, *CEA-LITEN, Grenoble, France*. Dr. Dini received his master of engineering degree in material science from the Ecole des Mines de Nancy (France) as well as a master of science degree in chemical engineering from the University of Alberta (Canada). In October 2019, he received his PhD degree in material science from the Université Grenoble Alpes. His PhD work was conducted at CEA, Grenoble and focused on understanding and improving the electrical transport in carbon nanotube yarns to reach high electrical conductivity applications. Dr. Dini has several articles published in the Carbon journal.