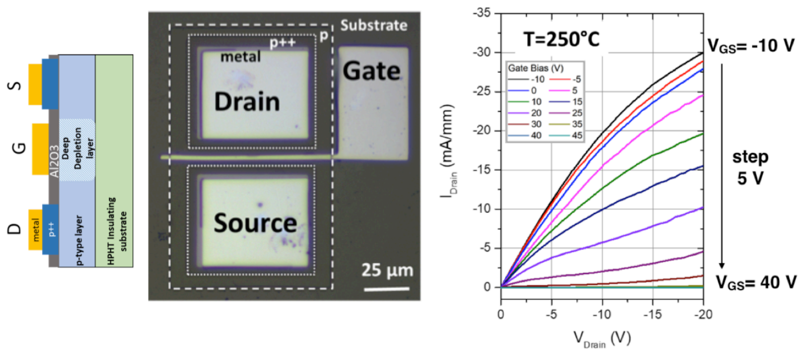
NÉEL INSTITUTE Grenoble

Topic for Master 2 internship – Academic year 2018-2019

DEEP DEPLETION DIAMOND MOSFET

General Scope:
Power electronic devices based on wide bandgap semiconductors will result in substantial improvements in the performance of power electronics systems by offering higher blocking voltages, improved efficiency and reliability (higher performance/cost ratio), as well as reduced thermal requirements thus leading to realization of more efficient green electronic systems. Among wide bandgap semiconductors, diamond is considered to be the ultimate semiconductor for applications in high power electronics due to its exceptional properties. Its dielectric breakdown strength is 3 times higher than in silicon carbide (SiC) or gallium nitride (GaN) and more than 30 times better than in silicon (Si). In addition, the carrier mobility is very high for both carrier types and the thermal conductivity is unsurpassed.

Research topic and facilities available:
In this context, we propose a new transistor concept: a deep depletion diamond MOSFET[1,2]. The originality of the concept is based on the huge minority carrier time constant needed to switch from the deep depletion to the inversion regime thanks to the ultrawide bandgap of diamond and making the deep depletion regime stable[1]. In this project, the training student will measure the electrical characteristics of diamond MOSFET using Institut Néel facilities. He/She will also analyze the data, propose new experiments and improvements in order to exploit the outstanding properties of diamond semiconductor. The student will be integrated in a group of few researchers working on this topic.



From left to right: Schematic cross section, top view optical image and characteristics of a deep depletion diamond MOSFET.

Reference:
[1] T.T. Pham, N. Rouger, C. Masante, G. Chicot, F. Udrea, D. Eon, E. Gheeraert, and J. Pernot, Appl. Phys. Lett. 111, 173503 (2017). https://doi.org/10.1063/1.4997975
[2] T.T. Pham, J. Pernot, G. Perez, D. Eon, E. Gheeraert, and N. Rouger, IEEE Electron Device Letters 38, 1571 (2017). https://doi.org/10.1109/LED.2017.2755718

Possible collaboration and networking: Nicolas ROUGER (LAPLACE, Toulouse, France).
Possible extension as a PhD: Yes
Required skills: We look for highly motivated student with knowledge in solid state physics, semiconductor physics as well as good skills for experimental work.

Starting date: Flexible
Contact:

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