NÉEL INSTITUTE Grenoble

Topic for Master 2 internship – Academic year 2018-2019

2D HOLE TRANSPORT IN DIAMOND SEMICONDUCTOR

General Scope:

Among wide bandgap semiconductors, diamond is considered to be the ultimate semiconductor for applications in high power electronics due to its exceptional physical properties. One of its superior properties is the elevated hole carrier mobility value (μ_h=2000 cm^2/Vs for a review see Ref. 1). Unfortunately, most of the diamond transistors fabricated nowadays are based on carrier transport within a 2D gas and are not able to reach such high values. This is the case of accumulation mode H-terminated field effect transistor (FET), Boron delta-doped FET, AlN/diamond heterostructure FET and inversion regime FET.

Research topic and facilities available:

In this context, the understanding of the physical origin of the limitations of the carrier mobility in these FETs is crucial. The training student will collect the data from the literature and develop/adapt an existing code (MATLAB for 3D bulk transport see Figure) in order to clarify the different scattering mechanisms involved in the 2D hole gas mobility of diamond transistor. He/she will compare his calculation with the results from the literature and the ones of the Institut Néel group.

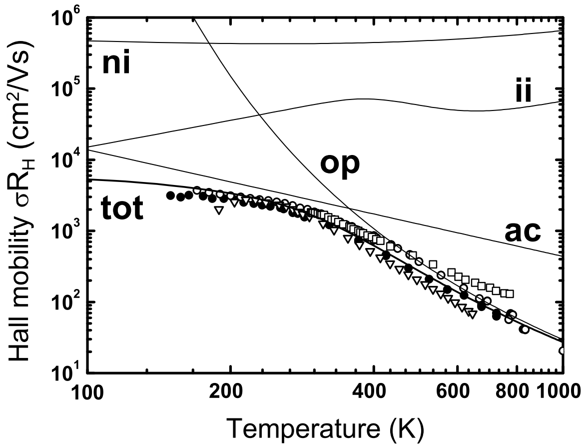

Figure: Hole mobility of low boron doped diamond. The symbols are the experimental data and the lines correspond to the calculations using the existing program and published in Ref 2.

References:

[1]J. Pernot « Carrier mobility in diamond: from material to devices » published in « Power Electronics Device Applications of Diamond Semiconductors - 1st Edition » ed by S. Koizumi, H. Umezawa, J. Pernot and M. Suzuki, 2018, Woodhead Publishing Elsevier, ISBN: 9780081021835

[2] Pernot, J., Volpe, P.N., Omnès, F., Muret, P., Mortet, V., Haenen, K., Teraji, T., 2010. Hall hole mobility in boron-doped homoepitaxial diamond. Phys. Rev. B 81, 205203.
https://doi.org/10.1103/PhysRevB.81.205203

Possible collaboration and networking: Yes
Possible extension as a PhD: Yes but extended to experimental work.
Required skills: We look for student with knowledge in solid state physics, semiconductor physics as well as motivation for calculation thanks to computer code.

Starting date: Flexible
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