Laboratoire
d'électronique
et de technologie

DPFT

Post-doc fellowship
(12 months-extendible, starting from January 2021)

Title: Development of combined cathodoluminescence and photosensitive Kelvin probe force microscopy protocol for LED applications

Framework and context:

The minority carrier recombination time or minority carrier lifetime is essential in the case of several devices like light emitting diodes, solar cells or transistors. Specifically for light emitting devices, a short lifetime is required for the best operation of these devices. However, this requirement concerns only to the radiative recombination as this recombination generates the photon emission. All non-radiative recombinations are not desirable in the case optimized LED device and these recombinations must be minimalized.

Several techniques can be used to measure minority carrier lifetime without lateral resolution. Nerveless, Kelvin Probe Force Microscopy (KPFM) and CathodoLuminescence (CL) permit to obtain images with nanometric resolutions. Use of these techniques together can be very advantageous to obtain local information about radiative and non-radiative recombinations from CL and KPFM respectively.

Work description:

During this post-doc fellowship, the applicant will be involved in development of very innovative characterisation techniques. More specifically:

(1) CL mapping will be compared with KPFM photovoltage mapping on different types of materials (GaN and InGaN) to see the impact of defects (e.g. dislocations, V-pits, etc.) on measured signals. Analysis protocol will be developed to properly compare the KPFM and CL measurement,

(2) the protocol of sample preparation will be developed to mark the sample on desired area. This preparation will allow to perform the both characterization techniques within the same sample area and will allow to analyze the proportion of radiative and non-radiative recombinations on defects,

(3) pump-probe KPFM will be tested to obtain recombination time of non-radiative process.

The applicant must be strongly motivated to learn how to handle advanced UHV facilities and analyse the data. He will have the opportunity to develop transverse skills as the work will be carried out with academic collaborators, and will involve issues of intellectual property, industrial experience with the LETI partners and a daily practise of the English language. Proper background in solid-state physics is essential. Basic knowledge about scanning probe microscopy or/and luminescence techniques is not mandatory but will be appreciated.

Host institution Direction/Department/Service	DRT/LETI/DPFT/SMCP
Postal address	CEA/GRENOBLE 17 av des Martyrs 38054 Grenoble CEDEX 9
Technical Supervisor	BOROWIK Lukasz Telephone : +33 4 38 78 93 31 E-Mail : Lukasz.Borowik@cea.fr