Contribution ID: **61** Type: **WG6 - Wide bandgap materials**

RD50 GaN Schottky Diodes Fabrication at IMB-CNM - Preliminary Results

Thursday 5 December 2024 09:40 (20 minutes)

Wide band-gap (WBG) semiconductors, specifically SiC and GaN, have shown increasing use in industry as transformative innovations for high-efficiency and high-power electronic devices. They stand as some of the most promising contenders for a new generation of semiconductors that could overtake Si in certain fields. Due to this greater commercial use, developments have been made in the growth of WBG substrates, displaying fewer defects. This opens up the door for wider commercial applications, one of the most encouraging being their use as radiation detectors. Specifically, for high energy physics and space applications. Some properties of WBG semiconductors like high radiation hardness, high thermal stability and high signal-to-noise ratios are fundamental to these applications [1]. Despite their advantages, considerable work remains in characterizing and optimizing these devices to enable them to replace silicon in certain domains, as in radiation detectors applications. GaN's main advantages extend from its high band gap (3.4 eV) and high Ga-N bond strength, suggesting both high temperature and radiation resilience. A few reports have assessed the usefulness of GaN as radiation detectors, specifically as α-particle, x-ray, neutron and electron detectors. Though many of these have been shown on a GaN eptaxial layer grown on Si, SiC or sapphire bulk. It is still not fully understood the extent of harsh environment robustness and radiation detection efficiency of GaN on GaN devices [2]. As a result, adoption of GaN technologies in high-radiation environments, such as the future FCC at CERN, requires a deeper understanding of radiation effects on GaN devices [3,4], so as to propose possible strategies to enhance their radiation hardness.
In this work, basic Schottky diode test structures intended for radiation detectors studies have been fabricated on non-intentionally doped n-type epitaxial GaN layers grown on 2-inch diameter bulk GaN substrates. The design of the Schottky structures include different layouts, with different sizes, geometries and guard rings. Preliminary electrical characterisation of the devices, including before and after first Schottky metal annealing step (required to stabilize the properties of the Schottky contact) is being carried out by means of current-voltage (I-V) and capacitance-voltage (C-V) techniques [5]. The obtained results and performed analysis will be given at the Workshop.

[1] I. Capan. Wide-Bandgap Semiconductors for Radiation Detection: A Review. Materials, 17(5), 1147, 2024.
[2] S. J. Pearton, R. Deist, F. Ren, L. Liu, A. Polyakov, J. Kim, Review of radiation damage in GaN-based materials and devices, J. Vac. Sci. Technol. A 31, 050801, 2013.
[3] J. Wang, et al. Review of using gallium nitride for ionizing radiation detection. Appl. Phys. Rev. 2, 031102, 2015.
[4] A. Sandupatla, S. Arulkumaran, N.G. Ing, S. Nitta, J. Kennedy, H. Amano. Vertical GaN-on-GaN Schottky diodes as α-particle radiation sensors. Micromachines, 11(5), 519, 2020.
[5] A. Walker, et al. Development of radiation-hard GaN devices for MIP detection - Phase I, 1st DRD3 week on Solid State Detectors R&D, CERN, 17-21 June 2024, abstract no. 24.

Type of presentation (in-person/online)

in-person presentation

Type of presentation (I. scientific results or II. project proposal)

I. Presentation on scientific results

Authors: Dr RAFÍ, Joan Marc (Instituto de Microelectrónica de Barcelona, CNM-CSIC); Mr NICKSON, Jack (Instituto de Microelectrónica de Barcelona, CNM-CSIC); Dr MONTSERRAT, Josep (Instituto de Microelectrónica de Barcelona, CNM-CSIC); WALKER, Alex (National Research Council of Canada); NOEL, Jean-Paul; Dr GRIFFIN, Ryan (National Research Council); VILLANI, Giullio (Rutherford Appleton Laboratory); KOFFAS, Thomas (Carleton University (CA))

Presenter: Dr RAFÍ, Joan Marc (Instituto de Microelectrónica de Barcelona, CNM-CSIC)

Session Classification: WG6 - WBG sensors