Project 6.2. The investigations of deep defect states in GaN by capacitance-based spectroscopy methods

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Background:

Gallium nitride technologies have revolutionized domestic lighting and have the potential to make a comparable impact on power and very high frequency electronics. This project is about one of the barriers which, at the present time, limit the performance of GaN transistors, namely electrically active states in the material resulting from point defects involving carbon and vacancies.

Almost all work to date has been undertaken on hetero-structures which produce strained and highly dislocated layers. Although our ultimate goal is to understand such material the high concentration of defects and their interactions has made establishing their role and formation mechanisms extremely challenging.

Homo-epitaxy is ideal as a tool to achieve an understanding of defect formation and this project addresses these issues.

In this project, we focus on carbon and vacancy-related defects created in GaN-on-GaN samples. The vacancies will be created during the growth and in the processes of electron irradiation. In this manner we will have access to two different sources of vacancies: self-created and artificially created. The carbon impurity will be introduced during the growth only.

In the project, we would like to verify experimentally the results of theoretical calculations of carbon and vacancy-related deep levels in GaN recently published by Matsubara and Bellotti in 2017.

The project is carried out in close cooperation with the School of Electrical and Electronic Engineering, The University of Manchester, UK.

Aim:

The aim of the project is to investigate the mechanisms of defect formation in epitaxially grown gallium nitride (GaN) layers: (1) as-grown, (2) doped with carbon and (3) irradiated with electrons. The vacancies will be created during the growth and in the processes of electron irradiation. The carbon impurity will be introduced during the growth only. The influence of defects on the physical properties of investigated structures, such as structural, electrical and optical properties, will be determined.

Requirements:

completed higher education (MSc) in the field of: physics, materials engineering, electronics or similar; knowledge of the English language, orderliness; strong motivation and willingness to work; practical programming skills in LabView and /or Matlab are very welcome; practical knowledge of nitride materials can be additional advantage