Announcing the Final Examination of Jonathan Lee for the degree of Doctor of Philosophy in Physics

Date: 22 June 2018
Time: 10:00 AM
Room: PS 160

Dissertation Title: Impact of Radiation and Electron Injection on Carrier Transport Properties in Narrow and Wide Bandgap Semiconductors

Abstract:

This study investigated the minority carrier properties of wide and narrow bandgap semiconductors. Included specifically are wide bandgap materials GaN and β-Ga_2O_3, and narrow bandgap InAs/GaSb type-II strain-layer superlattice. The importance of minority carrier behavior in bipolar device performance is utmost because it is the limiting component in current conduction. The techniques used to determine minority carrier properties include electron beam induced current (EBIC) and cathodoluminescence (CL) spectroscopy. The CL spectroscopy is complemented with time-resolved CL (TRCL) for direct measurement of carrier radiative recombination lifetime.

The minority carrier properties and effect of high energy radiation is explored. The GaN TRCL results suggested an activation energy effecting carrier lifetime of about 90 meV which is related to nitrogen vacancies. The effects of ^{60}Co gamma radiation are demonstrated and related to the effects of electron injection in GaN-based devices. The effects of various high energy radiations upon Si-doped β-Ga_2O_3 minority carrier diffusion length and radiative lifetime are measured. The non-irradiated sample thermal activation energies found for minority carrier diffusion length were 40.9 meV, related to shallow Si-donors in the material. The CL results demonstrate that the bandgap of 4.9 eV is an indirect bandgap. The thermal activation energy decreased on 1.5 MeV electron irradiation but increased for 10 MeV proton irradiation. The increase in energy was related to higher order defects and their complexes, and influenced recombination lifetime significantly. Finally, the diffusion length is reported for narrow bandgap InAs/GaSb superlattice structure and the effect of ^{60}Co gamma radiation is demonstrated.

In general, the defects introduced by high energy radiations decreased minority carrier diffusion length, except for ^{60}Co gamma on AlGaN/GaN HEMT devices and high temperature proton irradiated β-Ga_2O_3.

Outline of Studies:
Major: Physics

Educational Career:
B.S., 2012, University of Central Florida; **M.S., 2015**, University of Central Florida

Committee in Charge:
Dr. Elena Flitsiyan (Chair)
Dr. Leonid Chernyak
Dr. Robert Peale
Dr. Nina Orlovskaya (External Committee Member)

Approved for distribution by Dr. Elena Flitsiyan, Committee Chair, on June 11, 2018.

The public is welcome to attend.