

Presentation title: Studies of Charge Injection Effects in Wide Bandgap Semiconductors: GaN; ZnO; Ga₂O₃

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Abstract:

This work summarizes research focused on the impact of various types of radiation and electron injection, from either low energy electron beam or due to forward bias, on minority carrier transport in n- and p-type Gallium Oxide, as well as on the previously studied Gallium Nitride and Zinc Oxide semiconductors.

In Ga₂O₃, once bipolar devices become available, minority carrier transport (diffusion length) will be of primary importance. Minority carrier diffusion length defines performance of bipolar devices such as p-n junction diodes, bipolar transistors, and p-i-n detectors. One of the major issues in the current ultra-wide band gap materials technology, is the low diffusion length of minority carriers, partially due to dislocation scattering. It has been shown, however, that electron injection in n- and p-type Gallium Oxide results in a significant increase of the minority carrier diffusion length, even after its deterioration due to exposure to alpha- and proton-irradiation. Furthermore, post electron injection diffusion length in irradiated material exceeds that in Ga₂O₃ prior to irradiation and injection. The root cause of the electron injection-induced effect is attributed to increase of minority carrier lifetime in the material due to non-equilibrium electrons trapping on native point defects. It is thus concluded that the electron injection is capable of “healing” the adverse impact of radiation on ultra-wide band gap materials and can be used for control of minority carrier transport and, therefore, bipolar device performance.

Biography:

Dr. Chernyak received his PhD in Physics of Semiconductor Materials from Weizmann Institute of Science (Israel) in 1996. He spent several years as a Research Associate in the Departments of Electrical Engineering at Colorado State University (Fort Collins, Colorado, USA) and Texas Tech University (Lubbock, Texas, USA) (1996-1997) and at Intel Corporation (1997-1999) as a member of technical staff. He joined UCF in 1999 where he is a professor.