

## Electron Injection-induced Effects in III-Nitrides

Leonid Chernyak  
Dept. of Physics  
Univ. of Central Florida

The transport properties of minority carriers are an important indicator for the quality of GaN and related materials. One of the main difficulties that must be overcome in GaN, is a reduced minority carrier diffusion length,  $L$ . Enhancement of minority carrier diffusion presents a serious technological challenge, since this can not simply be achieved by the growth of low defect level material. Limitations, especially in heteroepitaxy, arise from the lattice mismatch between GaN epitaxial layer and the underlying substrate. To obtain a pronounced increase of minority carrier diffusion length merely by reduction of carrier scattering on the dislocation walls, the threading dislocation density must be brought down to  $10^7 \text{ cm}^{-2}$  from typical levels of  $10^8$ - $10^9 \text{ cm}^{-2}$ .

It has been recently found [1-4] that electron injection into p-(Al)GaN - either from the electron beam of a Scanning Electron Microscope (SEM) or from the application of an external voltage in a solid state device - increases the critical minority carrier diffusion length and lifetime. Consistent changes were observed in the material's micro-scale optical properties and were attributed to charging of deep metastable Mg-dopant-related centers.

The novel effects, induced by electron injection in III-Nitrides, and the ways to exploit them for tailoring the material's fundamental properties will be discussed. Applications of the effects for performance improvement of optoelectronic devices will be demonstrated.

1. Leonid Chernyak, Alfons Schulte, E. Fred Schubert (2002)  
Influence of electron injection on performance of GaN photodetectors  
*Appl. Phys. Lett.*, Feb.11 issue, in press.
2. Leonid Chernyak, Andrei Osinsky, and Alfons Schulte (2001)  
Minority carrier transport in GaN and related compounds  
*Solid State Electronics*, **45**, pp. 1687-1702.
3. Leonid Chernyak, G. Nootz, A. Osinsky (2001)  
Enhancement of minority carrier transport in forward biased GaN p-n junction  
*Electron. Lett.*, **37**, pp. 922-923.
4. Leonid Chernyak, A. Osinsky, V. Fuflyigin, E.F. Schubert (2000)  
Electron Beam-Induced Increase of Electron Diffusion Length in p-type GaN and AlGaIn/GaN superlattices  
*Appl. Phys. Lett.*, **77**, pp. 875-877.