Kinetics of Minority Carriers in GaN Epilayers Doped with Rare-Earth Elements

V.V. Krivolapchuk, M.M. Mezdrogina
Ioffe Physico-Technical Institute
Polyteknicheskaya str. 26, St. Petersburg, 194021, Russia
Natalia.Shmidt@mail.ioffe.ru

An investigation of photoluminescence (PL) spectra, kinetics of decay and evolution of these spectra is an efficient method for studying behavior of introduced impurities. The investigations of the III-nitrides doped with rare-earth elements (REE) demonstrated the ambiguity of the results, that was caused by structural variety of the III-nitrides.

In the present paper several groups of the GaN epitaxial layers grown by MOCVD and HVPE have been investigated. REE (Eu, Sm, Er) was introduced from a surface source to the epilayers differing in structural peculiarities characterized by the different type of mosaic structure and different position of Fermi level.

It has been established from the kinetics of decay and evolution of the PL spectra and the Mössbauer spectroscopy that the REE behavior is defined by the defect concentration and the Fermi level position. For GaN epilayers with the high defect concentration, that manifests as disintegrated and non-relaxed domains, REE occupies domain boundaries. In this case the defect-related bands have been observed in the PL spectra. Moreover the gettering effect took place, which has not been observed in the epilayers with the low defect concentration. It has been established that the intensity of the intracenter $f-f$ transitions in REE is larger for the GaN epilayers with lower concentration of defects.