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Microscopic structure of Er-optical centers in GaN epilayers by high magnetic fields[1]

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The incorporation of rare earth into wide bandgap semiconductors are of significant interest for optoelectronic devices, because of their temperature independent, atomic-like and stable emission together with the optical and electrical excitation. Er doped GaN materials have attracted much attention due to their capability to provide highly thermal stable optical emission in the technologically important as well as eye-safer at 1540 nm wavelength window. In spite of impressive developments in this area, the GaN:Er system remains poorly understood and even controversial in regard to the microscopic structure of optical Er centers and the relevant energy transfer mechanisms, which constitutes a barrier to further increases of device emission efficiency and thermal stability. The most straightforward approach to monitoring the microscopic structure of a luminescence center is direct detection via magneto-optical measurements of the main features of the emission spectrum. We have reported for the first time a successful observation and analysis of the Zeeman effect on the 1540 nm photoluminescence band in Er-doped GaN material grown by the metal-organic chemical vapor deposition in magnetic fields up to 17 T. The magnetic field induced splitting is observed for all the main lines of the Er photoluminescence spectrum. The angular dependence of the Zeeman splitting is measured in main crystallographic planes of the sample. The g-tensor of the ground and the first excited states is experimentally determined. The magneto-optical measurements and the temperature dependence of the PL spectroscopy show that our GaN:Er samples have two optical centers and they can be excited selectively under the resonant and non-resonant (band-to-band) excitations.

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