

Mg-doped GaN: Annealing and concentration-dependence probed by optically-detected magnetic resonance.

G. N. Aliev¹, S. Zeng¹, D. Wolverson¹, S. J. Bingham¹, J. J. Davies¹, and P. J. Parbrook²

¹ *Department of Physics, University of Bath, Bath, United Kingdom*

² *Department of Electronic and Electrical Engineering, University of Sheffield, Sheffield, United Kingdom*

Optically-detected magnetic resonance (ODMR) experiments have been carried out on a series of magnesium doped GaN layers grown by metal-organic vapour phase epitaxy, with particular emphasis on the changes produced by annealing of the layers in nitrogen and in oxygen atmospheres. As-grown specimens show both blue and green photoluminescence and the ODMR spectra are complicated, with signals due to magnesium-related acceptors and to a range of deep (i.e. not effective mass) donors. Both positive (luminescence enhancing) and negative (luminescence quenching) ODMR signals are observed, the signs and magnitudes of the signals being strong functions of the magnesium doping level.

Of particular interest is a previously unreported and extremely strong ODMR spectrum that appears as a series of luminescence-enhancing signals when the green region of the PL is monitored. The wavelength, angle and microwave frequency dependences of this spectrum have been comprehensively investigated and its spin Hamiltonian has been determined. The spectrum is unusual in that it can be described by two spin-half centres coupled by exchange and dipolar interactions of intermediate strength. Possible microscopic models will be discussed.

Following annealing, the ODMR spectra become much simpler, being dominated by signals due to the Mg-related acceptors and to one kind of deep donor; the spectrum observed in the green region is reduced or disappears. The annealing processes are thus confirmed to have eliminated several competing recombination pathways.