Optically-detected magnetic resonance studies of MBE ZnO:N

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To date, p-type doping of ZnO via nitrogen has proved difficult: the reasons are not understood and may be due to the manner in which the nitrogen is incorporated or due to the formation of compensating defects. One way of investigating such dopant and defect centres is through optically-detected magnetic resonance (ODMR), used here to study MBE-grown layers of ZnO:N.

The photoluminescence spectrum consisted of sharp excitonic features, a shallow donor/shallow acceptor pair recombination series and a broad emission band extending over the green region. The broad band is often observed in bulk ZnO and is usually the result of recombination between donor-like and deep acceptor-like centres. In confirmation of this, ODMR spectra detected by monitoring the intensity of such broad PL bands for bulk crystals have typically shown signals from shallow donors and from A-centres, which act as deep acceptors.

In the present case, four distinct ODMR spectra were observed, three with effective spins S=1/2 and one with S=1. One S=1/2 spectrum is due to shallow donors (e.g., gallium or aluminium) and one is attributable to oxygen vacancies. The third S=1/2 spectrum is highly anisotropic and, whilst it occurs in the range expected for A-centres, its *g*-values are quite different. The parameters are consistent with a model in which the holes are trapped at zinc interstitial ions lying at distorted octahedral sites. The S=1 spectrum is consistent with a triplet state formed by exchange-coupled pairing between the third type of S=1/2 centre and a shallow donor.