ESR Measurements of a GaN:Mg Thin Film

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Introduction

Mg-doping of GaN offers the only method of achieving technologically useful p-type GaN for today's white-light LED's and future high frequency electronics. However, the conductivity produced using the Mg acceptor is limited by several factors related to the impurity itself and the surrounding lattice. This work attempted to understand the origins of an ESR signal common to all Mg-doped GaN films, an anisotropic signal with g-factor of about 1.97~2.1, and a linewidth at 10 GHz of about 100 G.

Experimental

The measurements were performed in a modified PPMS Quantum Design system at temperatures below 10 K, using a cavity perturbation technique, and also in a homodyne quasi-optical system at low temperatures. For the PPMS measurements, the GaN:Mg film on the sapphire substrate was placed inside the microwave cavity and measurements were performed in the 50-100 GHz range, at the cavity resonances. The transmission through the cavity was recorded versus the applied magnetic field. In the homodyne system, the sample was placed inside the circular waveguide with the modulation coil outside; the transmission was measured in the 50-200 GHz frequency range versus the external magnetic field, which was perpendicular to the film surface.

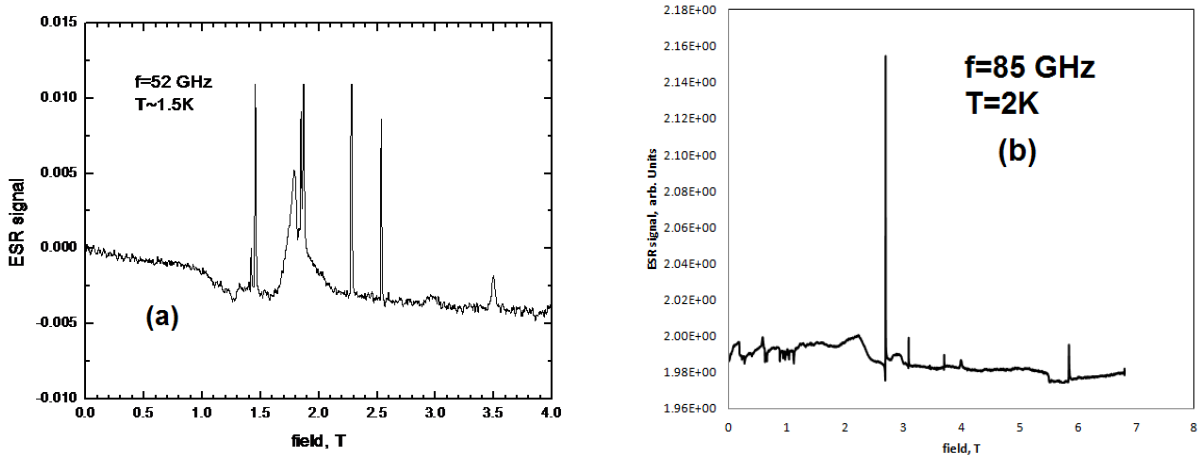

Figure 1. ESR signal measured in the (a) homodyne system and (b) PPMS system. The magnetic field is perpendicular to the film surface.

Results and Discussion

As we can see in **Figure 1**, the ESR signal from the sample has several sharp lines. These lines also have angle dependence. After an analysis of the data and comparison with the low frequency results, we concluded that the Mg signal was not observable and the ESR lines belong either to impurities in the sapphire substrate or to some other impurities not related to the GaN:Mg film.

Acknowledgements

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