Identification of Pair Defects in SiC

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Introduction

Silicon Carbide (SiC) is one of the leading contenders in the search for a suitable semiconductor for high power, high temperature devices. Although commercial substrates are available, incorporation of nitrogen during growth remains a critical issue. We have studied a nitrogen-related point defect present in a wide variety of 4H and 6H polytypes of SiC using electron paramagnetic resonance (EPR) spectroscopy. High frequency EPR measurement and the dependence of the defect concentration on nitrogen incorporation supports the identification as a nitrogen-donor pair as has recently been suggested by others [1,2].

Experimental

The samples studied were grown by physical vapor transport by three different vendors. The amount of nitrogen, as determined by secondary ion mass spectroscopy (SIMS), ranged from 10^{16} – 10^{18} cm^{-3}, and the electrically measured net carrier concentration (N_d-N_a) varied between $5x10^{15}$ and $7x10^{17}$ cm^{-3}. EPR was performed between 15 and 30 K in the dark and after illumination using an in-house 10 GHz spectrometer and the 240 and 336 GHz spectrometer at NHMFL. Dr J. van Tol performed the high frequency EPR measurements.

Results and Discussion

Our previous results using a comparison of our 240 Hz and 10 GHz measurements show that the center in $7x10^{16}$ cm^{-3} N-doped 4H SiC is a pair center involving nitrogen on a site of cubic symmetry and a second, as yet unidentified defect. The existence of triplet N centers is suggested by newer data obtained from a 4H $5x10^{17}$ cm^{-3} N doped sample. We observed two defects with g-values for those expected from two centers composed of nitrogen on different sites. One center is thought to contain two cubic site nitrogens ($2N_c$) and one hexagonal site (N_h) and the other one is likely composed of one cubic site and two hexagonal site nitrogen atoms (N_c-$2N_h$). However, several assumptions related to this conclusion must be investigated before the model can be confirmed.

Conclusions

A talk was presented at the Spring 2008 Materials Research Society Meeting based on this work. M. E. Zvanut and J. van Tol, "Nitrogen-pair defect in 4H and 6H Silicon Carbide", Materials Research Society Meeting, Symposium D, San Francisco, CA, April 2008.

Acknowledgements

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References

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[2] S. Greulich-Weber, Phys. Stat. Sol. a **182**, 95 (1997).