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"Carrier Lifetimes in Silicon Carbide"

Friday, November 30, 2007
11:00 A.M. Seminar in Hamerschlag Hall B131
Refreshments precede seminar at 10:30 A.M. in 2325 Wean Hall

Carrier lifetimes are one of the most significant parameters affecting the performance of high voltage silicon carbide (SiC) bipolar devices. Qualitative correlations between carrier lifetimes and certain point defects in epitaxial SiC have been shown in literature. Therefore, the objectives of this research were to (i) identify recombination channels in SiC, (ii) present a quantitative analysis of the capture-recombination kinetics of carriers through these channels, and (iii) provide a means to control carrier lifetimes in high quality SiC epilayers.

Carrier lifetimes and deep levels spectra have been measured in a series of 4H-SiC n^--epilayers grown on Si- and C-face with varying C/Si ratio and growth temperature. Deep level transient spectroscopy and minority carrier transient spectroscopy showed the presence various electron and hole traps (native defects) in the investigated epilayers. Carrier lifetimes deduced from electron beam induced current (EBIC) and photoluminescence (PL) decay measurements were typically 100 – 1000 ns for Si-face grown samples and 50 – 80 ns for C-face grown epilayers. Electron and hole capture cross sections were measured for the Z-defect and EH6/7 centers (from the capture kinetics data), in order to ascertain lifetime limiting defect on Si-face samples. The theoretical estimate of 'Z-defect limited lifetimes' using the Shockley-Read-Hall model were in good agreement with the experimental data suggesting Z-defect as lifetime killer defects in Si-face epilayers. Anomalously low carrier lifetimes in C-face samples correlated with the presence of high concentrations of P1 center, indicating latter as lifetime limiting defect on C-face grown epilayers.

Lifetimes in Si-face grown samples showed anti-correlation with Z-defect concentration. The concentration of Z-defect can be decreased with increasing C/Si ratio or decreasing growth temperature.

Saurav received his Bachelors (Chemical Engineering) from Indian Institute of Technology, Roorkee in 2001, Masters (Chemical Engineering) from University of Florida in 2003, and Masters (Materials Science) from Carnegie Mellon University in 2004. He is currently a Ph.D. candidate under the guidance of Prof. Skowronski.