



AN 357

Improved Precision in SIMS Measurements of B, Al, and N in SiC

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Discussion

SiC is a very important material for high-power, high-temperature, and high-radiation devices. Dramatic progress in SiC power transistors, LEDs, and sensors have made it imperative to accurately control the dopant and impurity levels. Requirements for high yields demand reproducible dies across a wafer. SiC material vendors and device manufacturers would benefit from the solution to this problem.

The criterion is to be able to distinguish differences in doping levels across a wafer (center to edge). Due to its unique capabilities of high detection sensitivity for a variety of elements under depth profiling mode, Secondary Ion Mass Spectrometry (SIMS) is an essential tool for characterization of dopants and impurities in SiC material. Previous precision levels have been as high as 50-100% or more. This is unacceptably high. In terms of SIMS this means better precision of concentration and thickness measurements to monitor possible variation in these parameters.

We have developed new protocols to measure B, N, and Al in SiC that have significantly improved precision. Figures 2-4 show the results of long term precision studies of the three major dopants in SiC demonstrating excellent precision for B = 6%, Al = 11%, and N = 10% (1σ). Thickness determinations can detect variations to within 1-2%. Figure 1 illustrates a typical SIMS investigation of N concentration and epi thickness uniformity at five positions across a single SiC wafer. The concentrations at position 1 \neq positions 2 and 3 \neq positions 4 and 5. The epi-layer has a different thickness at all five positions. SIMS is thus a vital tool for determining the uniformity in doping concentration and epi thickness.

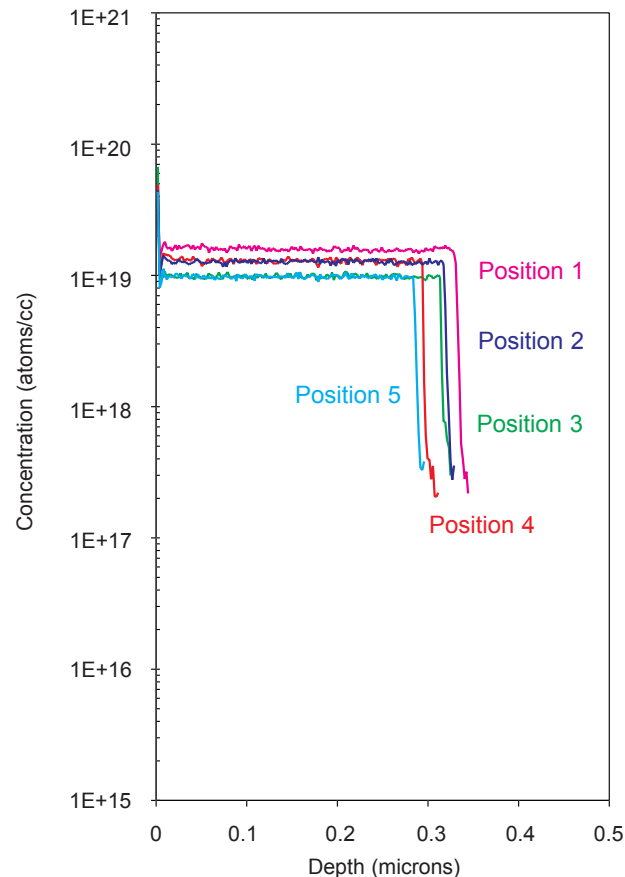


Figure 1. Variation of N Concentration and Epi Thickness Determined by SIMS

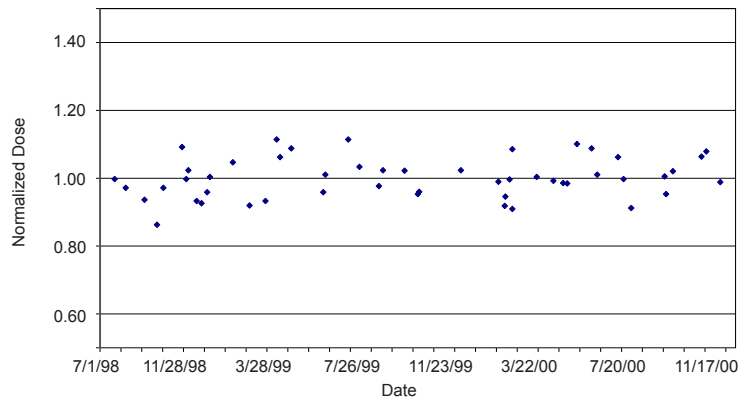


Figure 2. B in SiC: Standard Deviation (1σ) = $\pm 6\%$, range $< 30\%$

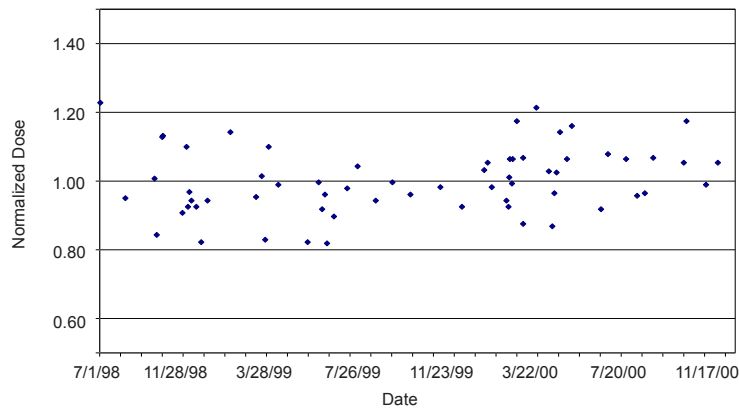


Figure 3. Al in SiC: Standard Deviation (1σ) = 11%, range of 40%

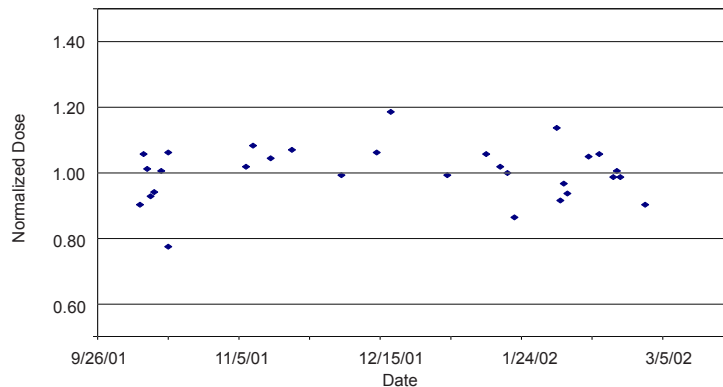


Figure 4. N in SiC: Standard Deviation (1σ) = $\pm 10\%$, range of 30%.

United States Locations

Tempe, Arizona
 +1 480 239 0602 info.az@eaglabs.com
 +1 602 470 2655 fax

Sunnyvale, California
 810 Kifer Road
 +1 408 530 3500 info.ca@eaglabs.com
 +1 408 530 3501 fax

1135 E Arques Avenue
 +1 408 738 3033
 +1 408 738 3035 fax

785 Lucerne Drive
 +1 408 737 3892
 +1 408 737 3916 fax

Peabody, Massachusetts
 +1 978 278 9500 info.ma@eaglabs.com
 +1 978 278 9501 fax

Chanhassen, Minnesota
 +1 952 828 6411 info.mn@eaglabs.com
 +1 952 828 6449 fax

East Windsor, New Jersey
 +1 609 371 4800 info.nj@eaglabs.com
 +1 609 371 5666 fax

Syracuse, New York
 +1 315 431 9900 info.ny@eaglabs.com
 +1 315 431 9800 fax

Raleigh, North Carolina
 +1 919 829 7041 info.nc@eaglabs.com
 +1 919 829 5518 fax

Round Rock, Texas
 +1 512 671 9500 info.tx@eaglabs.com
 +1 512 671 9501 fax

International Locations

Shanghai, China
 + 86 21 6879 6088 info.cn@eaglabs.com
 + 86 21 6879 9086 fax

Tournefeuille, France
 + 33 5 61 73 15 29 info.fr@eaglabs.com
 + 33 5 61 73 15 67 fax

Frankfurt, Germany
 + 49 (0) 693053213 info.de@eaglabs.com
 + 49 (0) 69307941 fax

Tokyo, Japan
 + 81 3 5396 0531 info.jp@eaglabs.com
 + 81 3 5396 1930 fax

HsinChu, Taiwan
 + 886 3 5632303 info.tw@eaglabs.com
 + 886 3 5632306 fax

Uxbridge, United Kingdom
 + 44 (0) 1895 811194 info.uk@eaglabs.com
 + 44 (0) 1895 810350 fax