Comparison of Carrier Lifetime Measurements and Mapping Using Time Resolved Photoluminescence and μ-PCD

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Aim

Comparison of carrier lifetime measurements, using either time resolved photoluminescence (TRPL) or microwave-detected photoconductivity decay (u-PCD), on the same SiC epitaxial layers.

Wafers

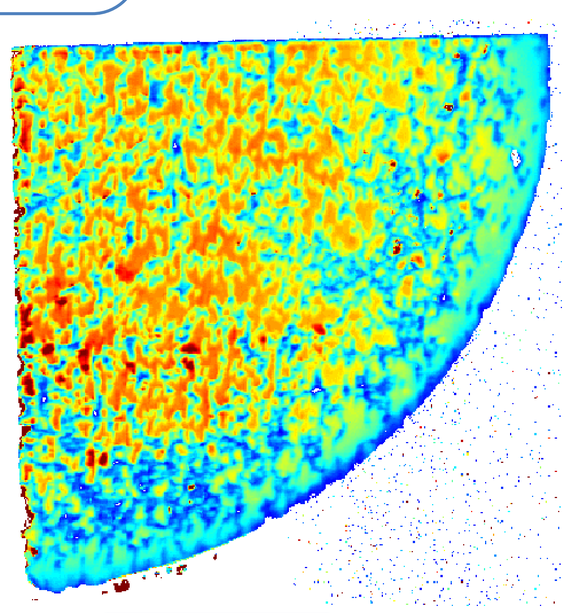
1. Quarter of 4" 4H SiC. 43 μm, $2x10^{15}$ cm^{-3}.
   High density of ingrown stacking fault.
2. Older 2" 4H SiC substrate. 43 μm, $1.5x10^{15}$ cm^{-3}.
   High dislocation density, and surface processed.
3. State-of-the-art 4" SiC substrate. 30 μm, $2x10^{13}$ cm^{-3}

Techniques

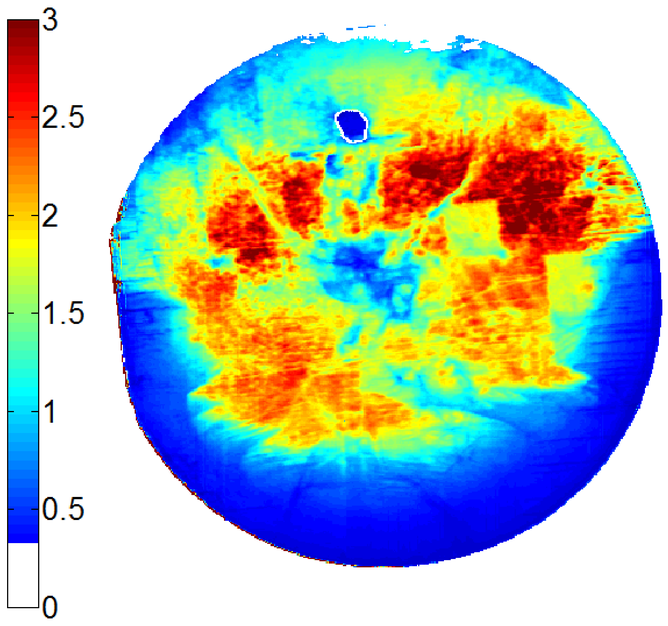
TRPL : Tripled Nd:YLF-laser, 350 nm,
Excitation density < 10^{15} cm^{-3}

μ-PCD : Laser-diode, 350 nm,
Excitation density > 10^{16} cm^{-3}

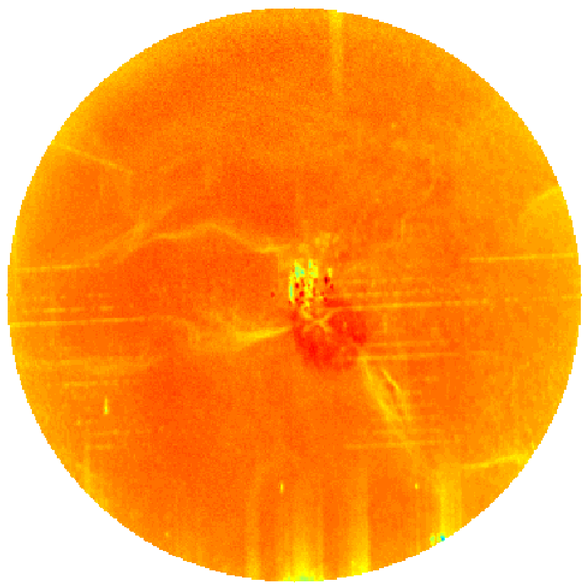
μ-PCD



Wafer 1

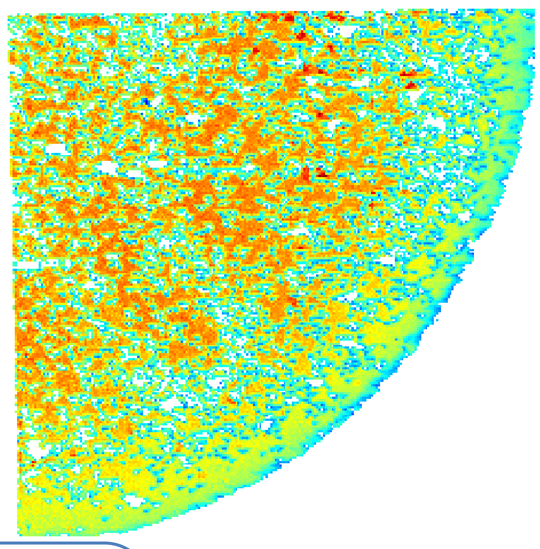


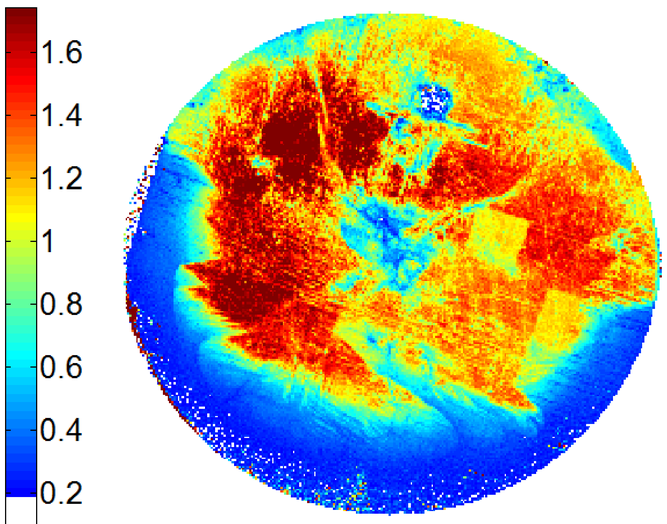
Wafer 2

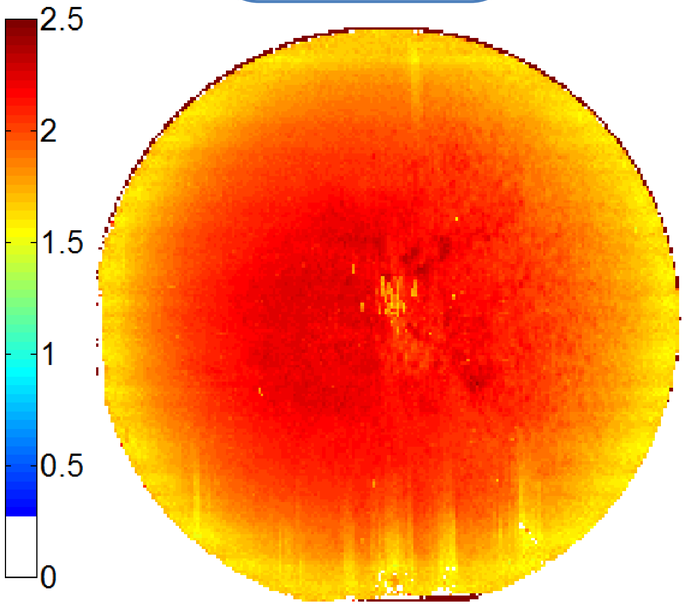


Wafer 3

TRPL







Conclusions

- TRPL gives values about half of the μ-PCD, as expected from recombination theory [1].
- Both techniques show similar variations related to substrate defects.
- Both techniques are sensitive for the presence of in-grown stacking faults in the epitaxial layer.

References

[1] P. B. Klein, J. Appl. Phys. 103 (2008) 033702.

Acknowledgments

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