Advanced Anneal Metrology Using BX-10

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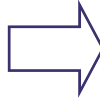
Outline

- System introduction
- Millisecond anneal process characterization

BX-10 Implant/Anneal Control System

Technology

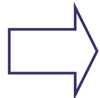
Carrier Illumination™



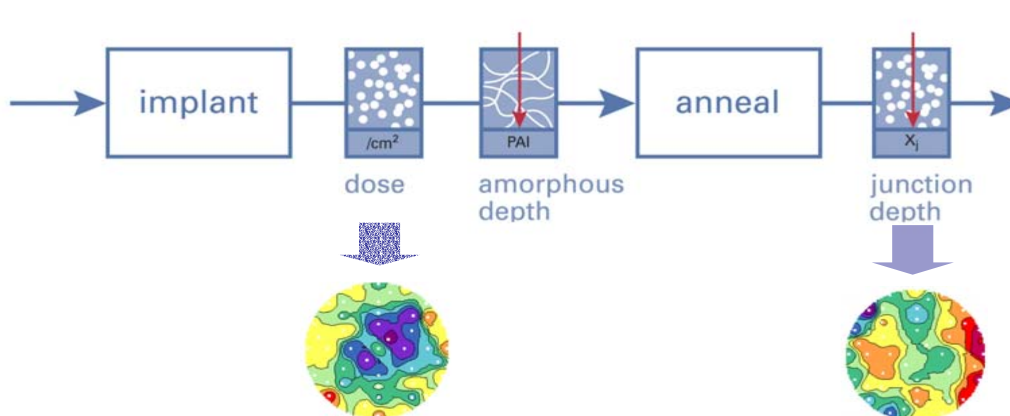
Optically measures entire implant-anneal module
- non-contact
- in-line

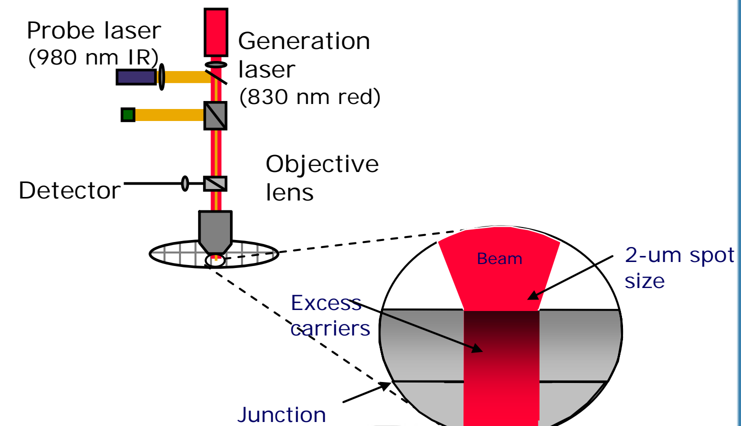
To measure

Applications



Post -implant	Dose, PAI
Post-anneal	Junction depth, RTP control
Advanced	Millisecond annealing, SOI, lateral diffusion, micro-nonuniformity





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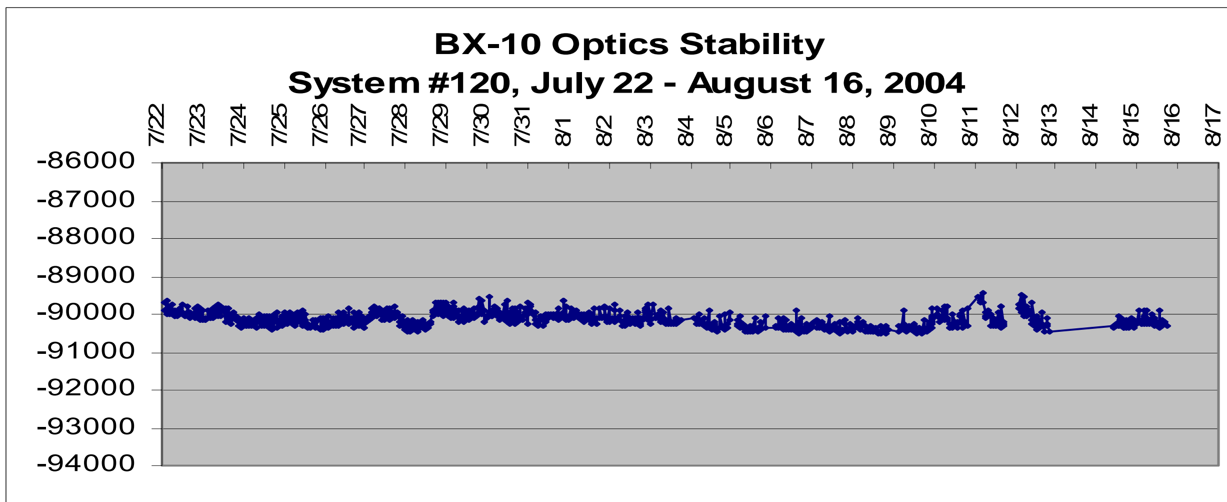
Enhanced Optics BX-10 system (introduced in 2004)

- Motivation- Robust metrology for in-line production use
  - High stability, repeatability, system matching
  - High MTBF, short MTTR
- Main Features
  - Tolerant optics design→ Low drift, repeatability <0.25% 1σ
  - On-board diagnostics → Speeds root cause identification of problems
  - External control of adjustable components → optical alignment without opening system



Excellent stability over 26 days (>913 runs)

Mean	-90167
Std Dev	191
Repeatability	0.21%

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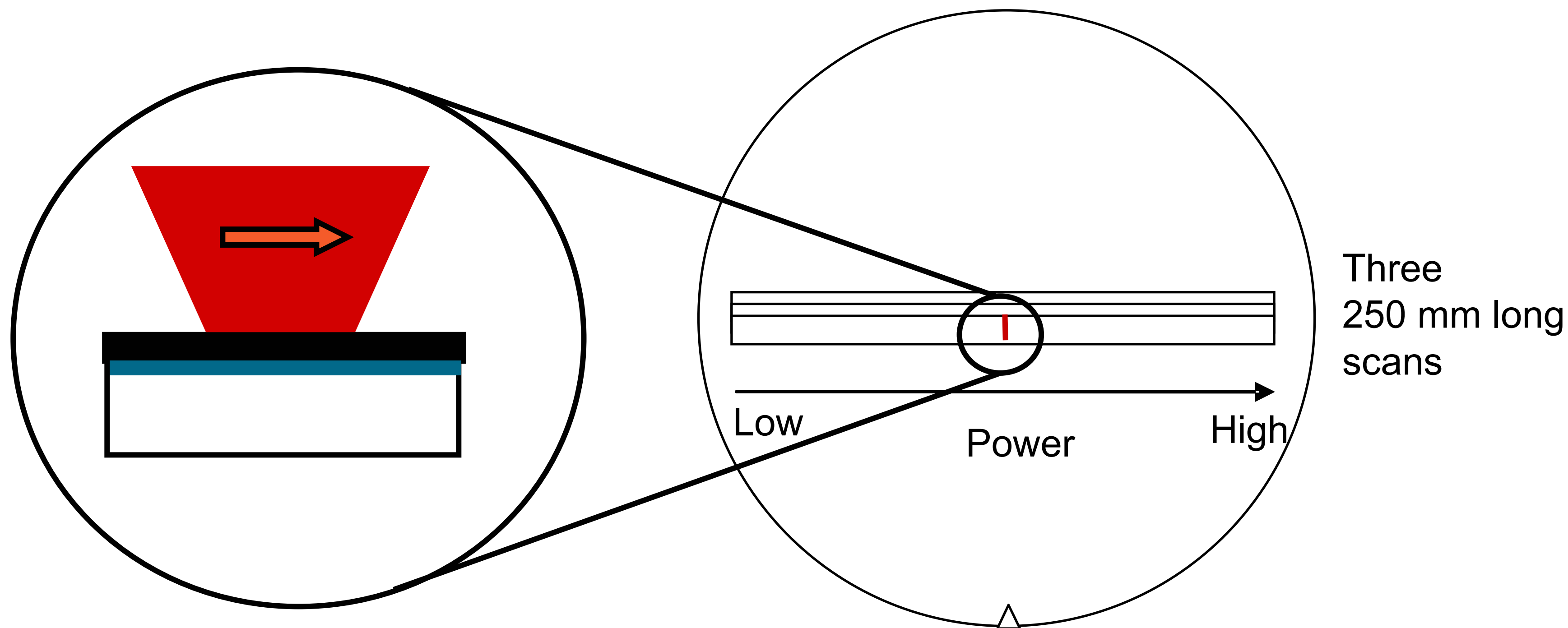
Millisecond anneal measurement

Millisecond anneal test



- 250 mm long stripe was annealed along the diameter of each wafer, consisting of 3 overlapped stripes with 3.5 mm distance
- Laser power was ramped from low (600 Watts) to high (1200 Watts) along the stripe
- To be presented at USJ Symposium in June

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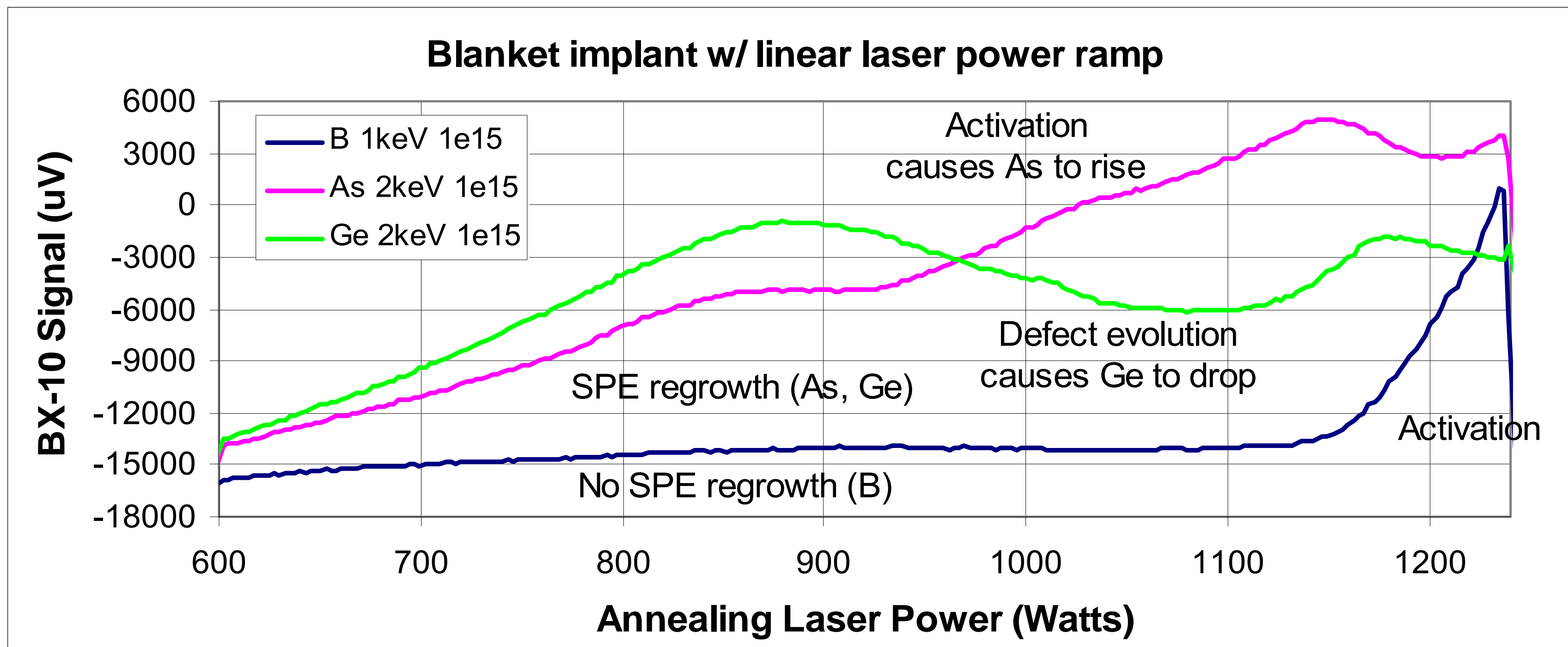
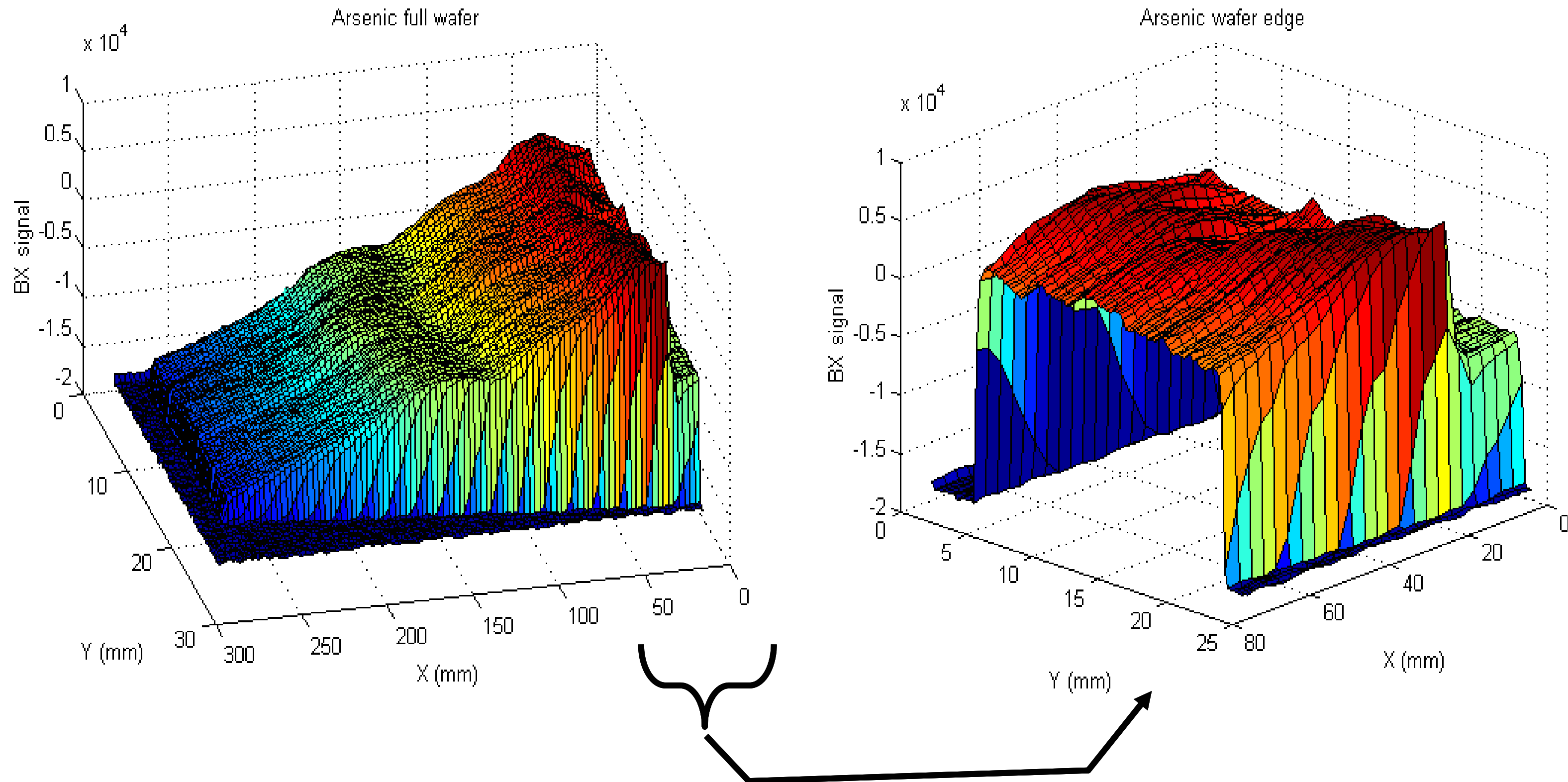
BX-10 response to annealing laser power



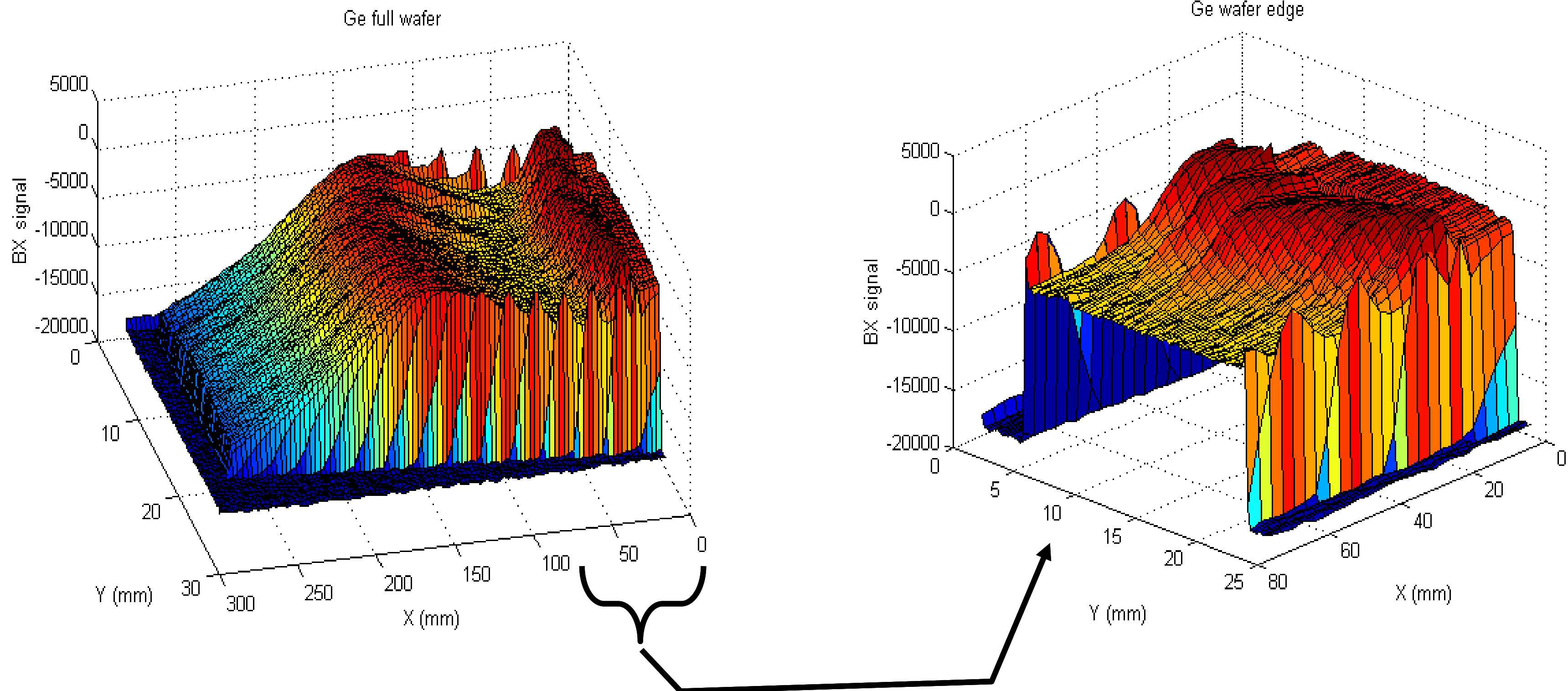
- SPE re-growth with As and Ge implants (amorphizing), none with B-implant (non-amorphizing)
- Different As and Ge behavior at higher laser power due to activation of As-dopant
- Steep Boron activation at high laser power

Arsenic



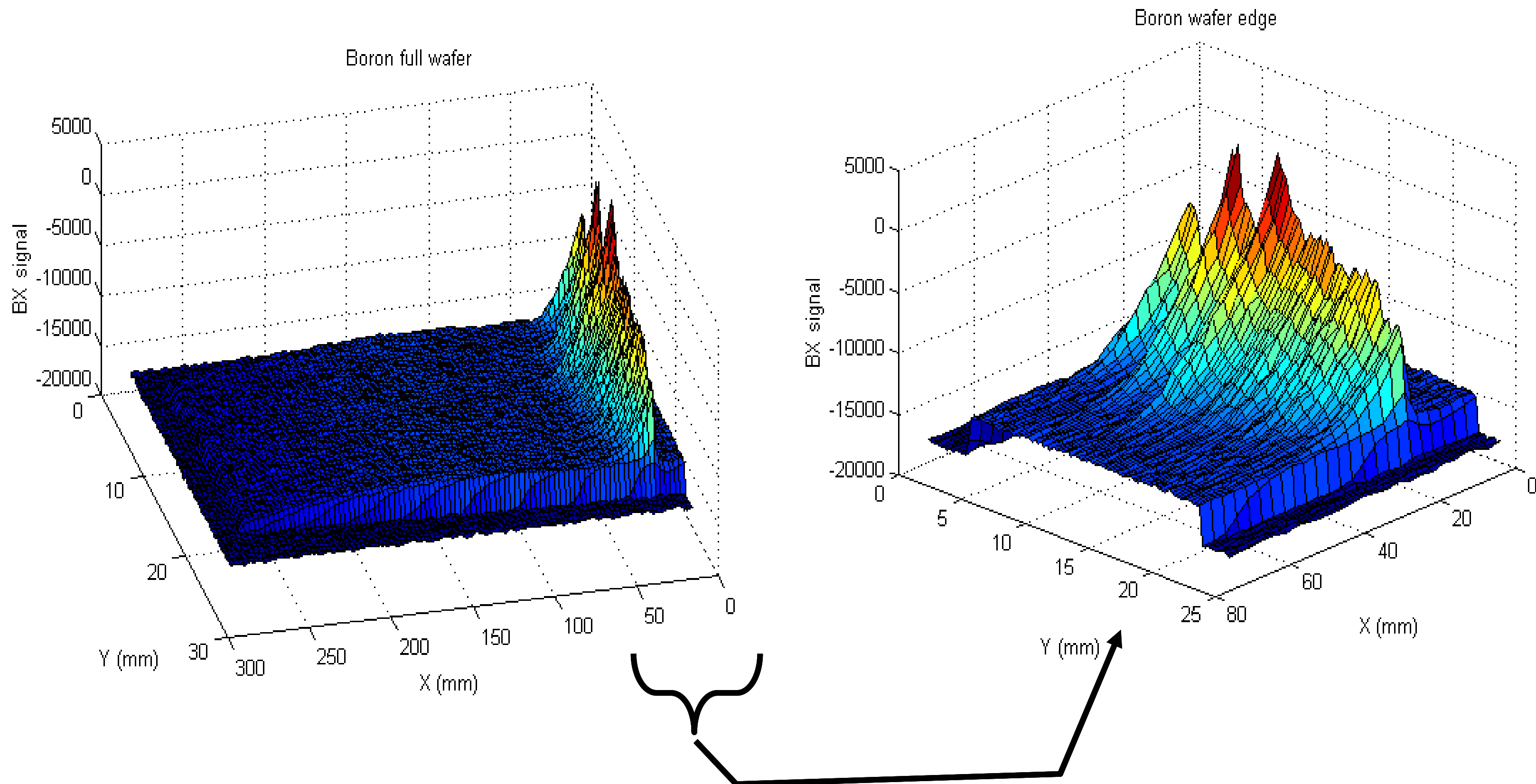
- 2D-map of laser-annealed stripe
- Excellent beam uniformity across the stripe

Ge



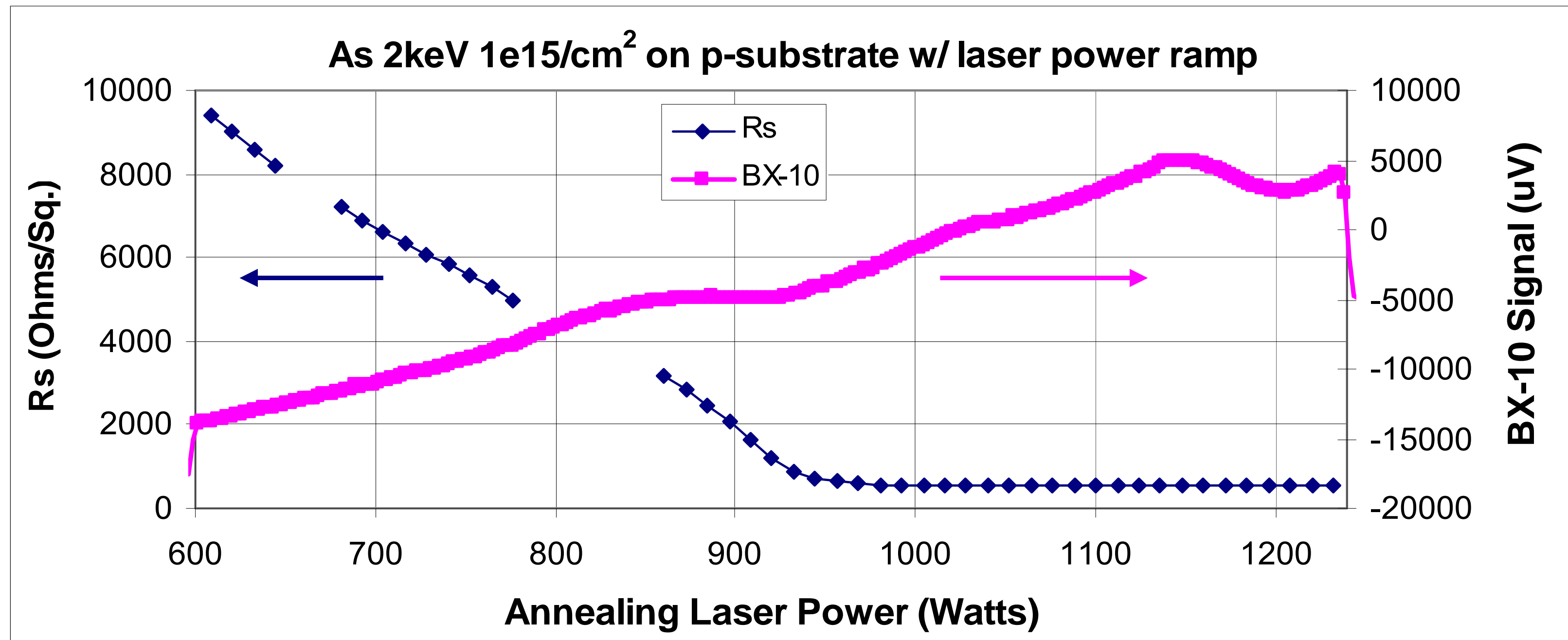
- 2D-map of laser-annealed stripe
- Excellent beam uniformity across the stripe

Boron



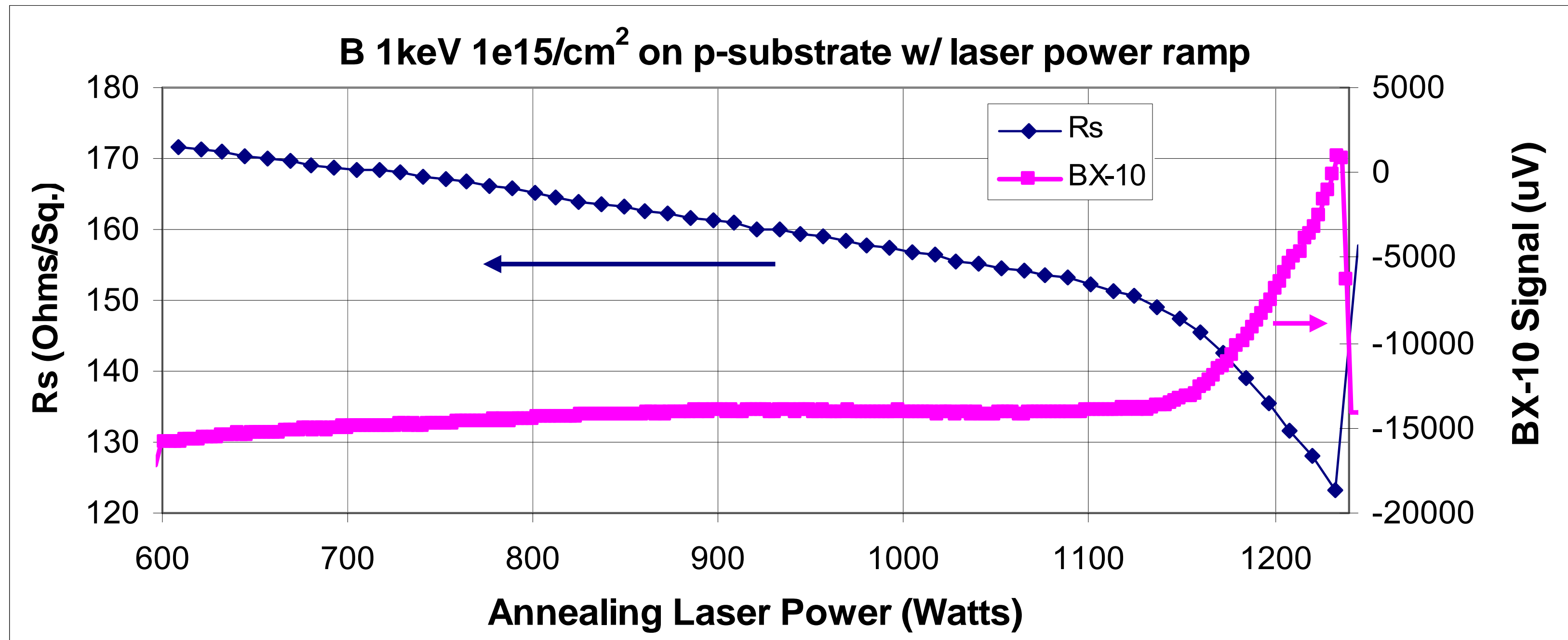
- 2D-map of laser-annealed stripe
- Large signal variation at high laser power due to steep signal response at high laser power region

BX-10 correlation to Rs (Arsenic)



- Rs decreases rapidly during the SPE re-growth part of the anneal, due to rapid implant damage removal.
- At laser power > 920 Watts, Rs loses sensitivity to the activation of the As dopants, but BX-10 signal continues to display strong response.

BX-10 correlation to Rs (Boron)



- With B-implant on p-type substrate, the Rs values indicate only relative activation, not the true sheet resistance.
- BX-10 signal correlates very well with Rs, responding steeply at peak Boron activation.

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Summary

- In millisecond annealing, the BX-10 is sensitive to the defect evolution of the implant damage, and to the activation of the dopant atoms at high annealing laser power.
- The small spot size (a few microns) of the BX-10 enables a high-resolution map of the laser annealing beam.
- High sensitivity, fast measurement time, and high spatial resolution of the BX-10 technique enable a rapid optimization of the millisecond annealing process.

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