



Sequential UV Mapping of Stacking-Fault Expansion for Wafer-Level Assessment of Bipolar-Degradation Susceptibility in 4H-SiC

Takuya Morita*, Kaoru Sugihara

ITES Co., Ltd., 1-60 Kuribayashi-chou, Otsu-shi, Shiga 520-2151, Japan
takuya_morita@ites.co.jp

Background

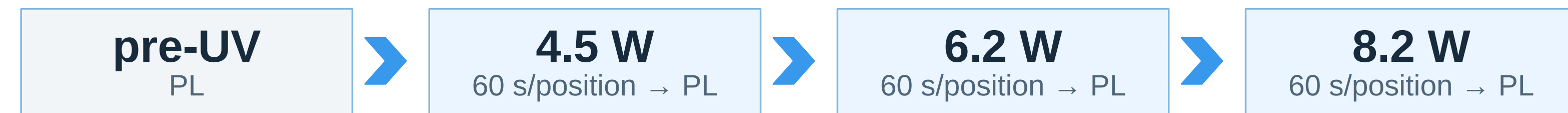
Electrical injection and UV irradiation both induce 1SSF expansion through carrier-related processes. Building on studies linking electrical and UV excitation [1,2], we aim to assess bipolar-degradation susceptibility at the wafer level.

PL images acquired after sequential UV irradiation were compared to evaluate new-region counts, step distributions and areas in two wafers.

Key result: new detections by 6.2 W
Wafer A / Wafer B
8.15% / 22.07%
2.71-fold distribution contrast

Experimental Methods and Results

Sequential UV exposure and PL imaging of the same wafer



Comparisons: pre-UV → 4.5 W → 6.2 W → 8.2 W
The same recipe distinguishes new regions from further expansion of existing regions.

Samples: two 6-inch 4H-SiC epitaxial wafers
UV: 355 nm, 60 kHz, room temperature
Irradiation: 2.19-mm square, 60 s/position/step
PL: 313-nm excitation, 420-nm BPF, 2-s exposure
Layer thickness: drift 10 μm / buffer 1 μm
Drift concentration [cm⁻³]: A 7.92×10¹⁵ / B 1.00×10¹⁶
ROI: 3-mm inward wafer-edge exclusion

Wafer maps at low and high power steps

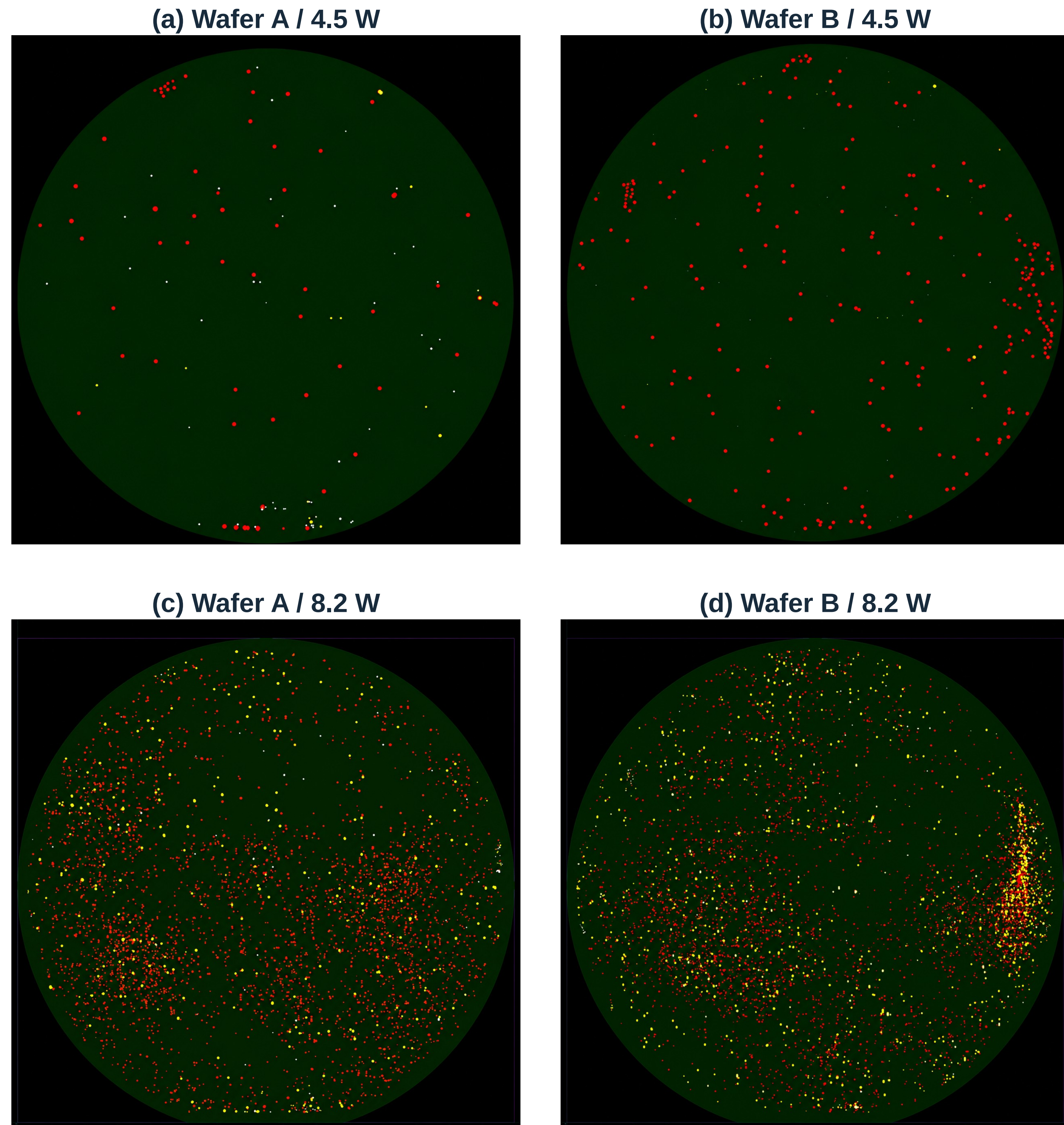


Fig. 1. Low- and high-power PL map displays.

● Red: newly classified regions ● Yellow: growth of existing regions

Red/yellow overlay areas are doubled for visibility; area measurements use the original data.
Colors indicate response categories, not threshold bins. Blank areas may still contain unexpanded latent defects.

Cumulative new-region detection fraction

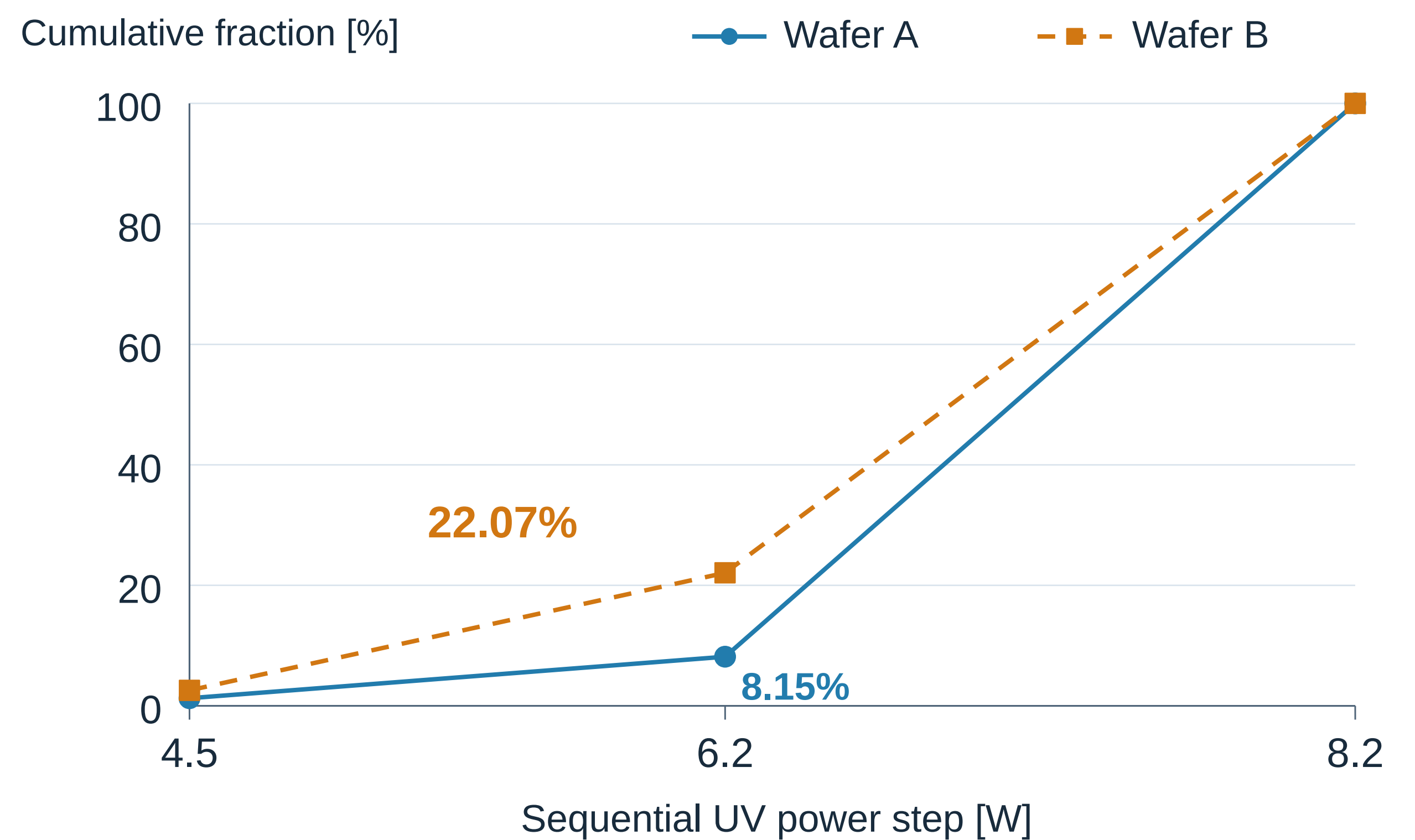


Fig. 2. Cumulative new-region fractions (lines are guides).

Fractions are normalized to the total new detections in this sequence.
100% at 8.2 W does not mean that all latent defects were activated.

New-region counts and areas at each step

UV power	Wafer A [regions]	Wafer B [regions]	Wafer A [mm ²]	Wafer B [mm ²]
4.5 W	262	669	0.170	0.414
6.2 W	1,435	5,081	1.194	4.781
8.2 W	19,122	20,299	18.422	18.517
Total	20,819	26,049	19.786	23.712

New area excludes further expansion of previously detected regions.

Total area-increase metric: pre-UV → 8.2 W [mm²]

Wafer A 33.998 | Wafer B 42.384

Total detections and final area metric: ~25% difference
Low-plus-middle-step fraction: 2.71-fold contrast

Discussion and Conclusions

- Sequential UV irradiation revealed differences in low- and middle-step response distributions that cannot be captured by the final expansion magnitude alone.
- New detections by 6.2 W accounted for 8.15% in A and 22.07% in B: a 2.71-fold contrast, compared with ~25% differences in total detections and the final area metric.
- Combining these maps with electrical–UV correspondence models offers a route to bipolar-degradation assessment before device fabrication. Calibration to target device conditions remains future work.

Scope: counts are new regions classified by in-house software; unexpanded latent defects are excluded. One wafer per specification was studied, so concentration effects were not isolated.

Acknowledgments and References

This work was supported by the METI R&D Support Program for Growth-oriented Technology SMEs (Grant Number JPJ005698).

[1] Y. Igarashi et al., Defect Diffus. Forum 434 (2024) 23-31. [2] Y. Igarashi et al., Mater. Sci. Forum 1190 (2026) 37-42.