

Influence of Technological Surface Structures for Super Junction Devices on 4H SiC Epitaxial Overgrowth

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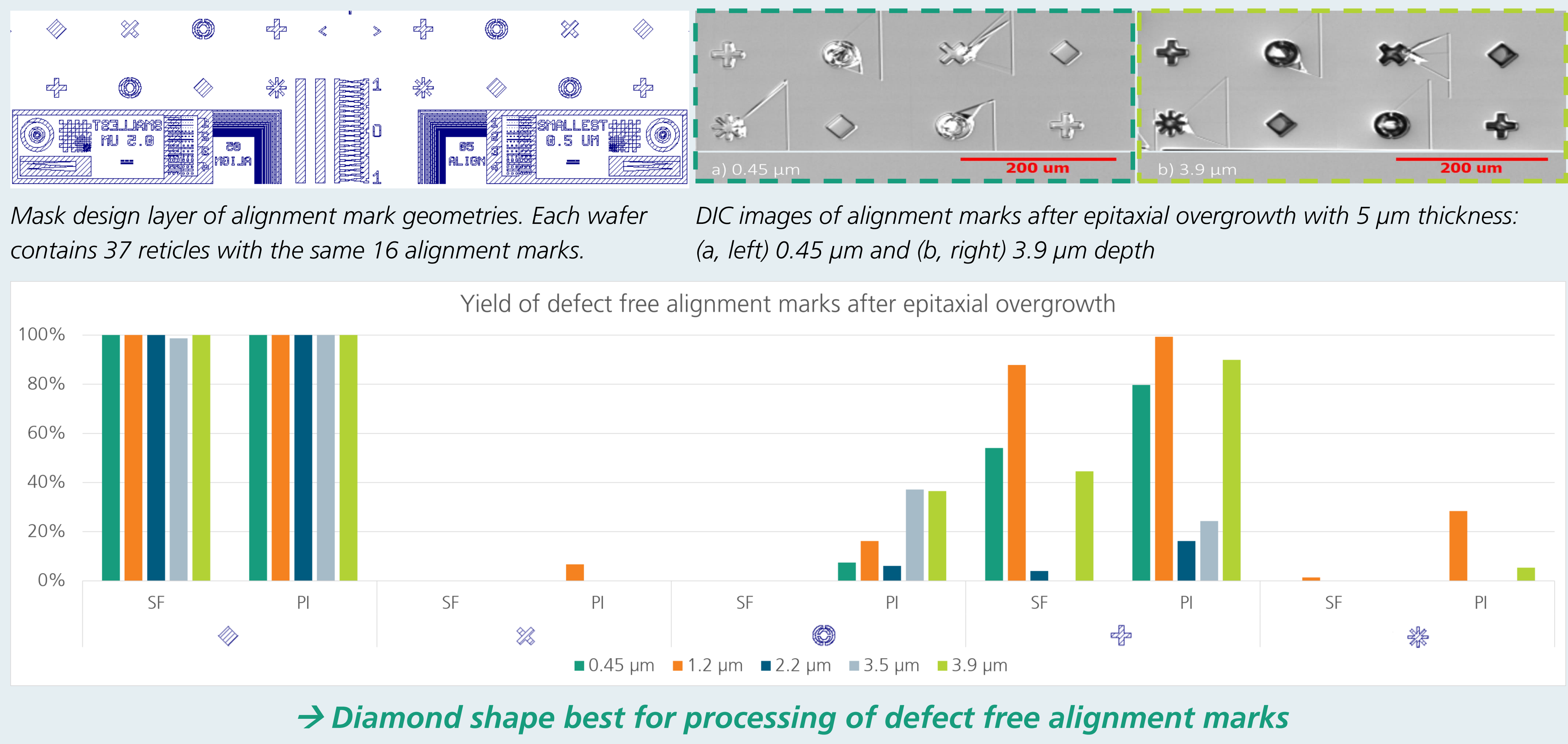
Motivation

- Super junction (SJ) structures can overcome the unipolar limit in 4H SiC power devices [1]
- Alignment precision during SJ processing is crucial for SJ-fabrication approaches, e.g. (1) trench refill, (2) multi-implant multi-epi, (3) sidewall trench implantation
- Epitaxial overgrowth of etched surface geometries is prone to create stacking faults (SF) and polytype inclusions (PI), altering surface morphology. This reduces alignment precision [2] → We examined different alignment mark and trench geometries after epitaxial overgrowth to evaluate alignment precision

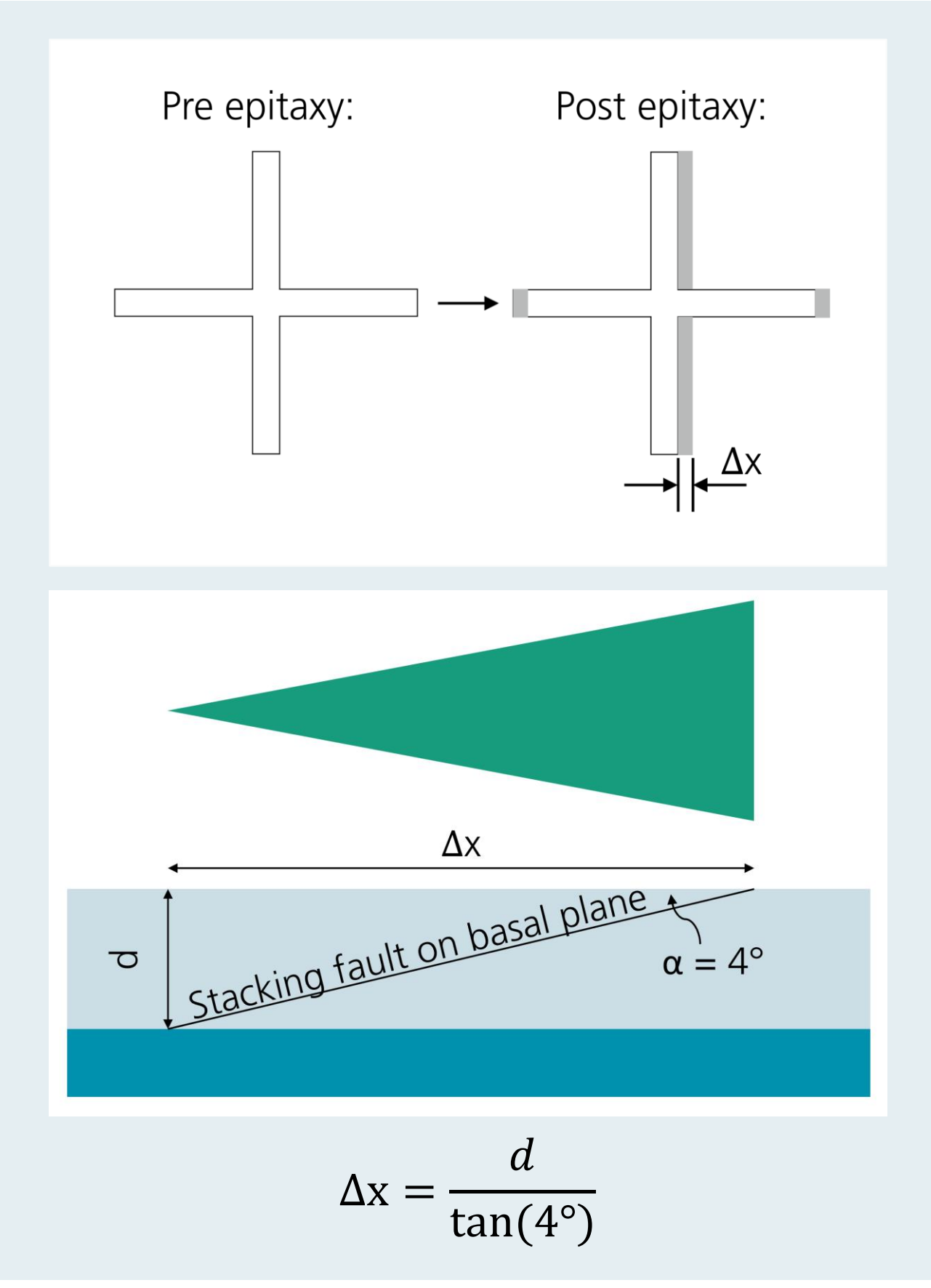
Design of Experiment

1 st n-Epi:	Alignment Marks:	2 nd n-Epi:	Characterization:
■ 5 epi wafers ■ 10 μm @ $1\text{E}16\text{ cm}^{-3}$ ■ All epi runs performed in AIXTRON G5 WW C & G10-SiC multi-wafer reactors	■ 5 different shapes ■ 5 different depths (one per wafer): 0.45, 1.2, 2.2, 3.5, 3.9 μm ■ Different side wall shapes (one per wafer)	■ 5 epi wafers ■ 5 μm @ $6\text{E}16\text{ cm}^{-3}$ drift layer ■ All epi runs performed in AIXTRON G5 WW C & G10-SiC multi-wafer reactors	■ Before and after 2nd epi ■ Lasertec SICA 88 (DIC & UV-PL) ■ Focused Ion Beam – cross sections

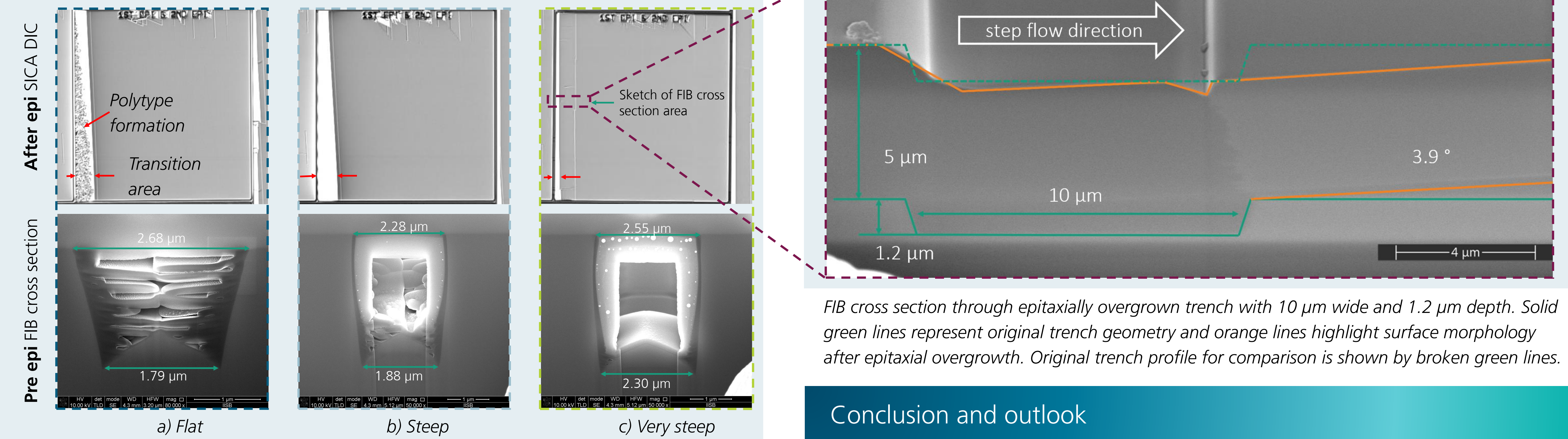
Yield evaluation of alignment mark shapes after epitaxial overgrowth



Correlation of epilayer thickness (d) and stacking fault length (Δx)



Overgrowth of varying etched trench wall geometries



Conclusion and outlook

- Steep etch flanks and diamond shape prioritized for alignment precision
- Quantifying alignment precision outstanding

Find our publications here:



1. L. Yu and K. Sheng, IEEE Trans. Electron Devices, vol. 55, no. 8, pp. 1961–1969, Aug. 2008.
2. Y. Chen et al., Jpn J Appl Phys, vol. 43, no. 7R, p. 4105, Jul. 2004.

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