Applied Vantage® Vulcan™ RTP

The Better Side of Anneal

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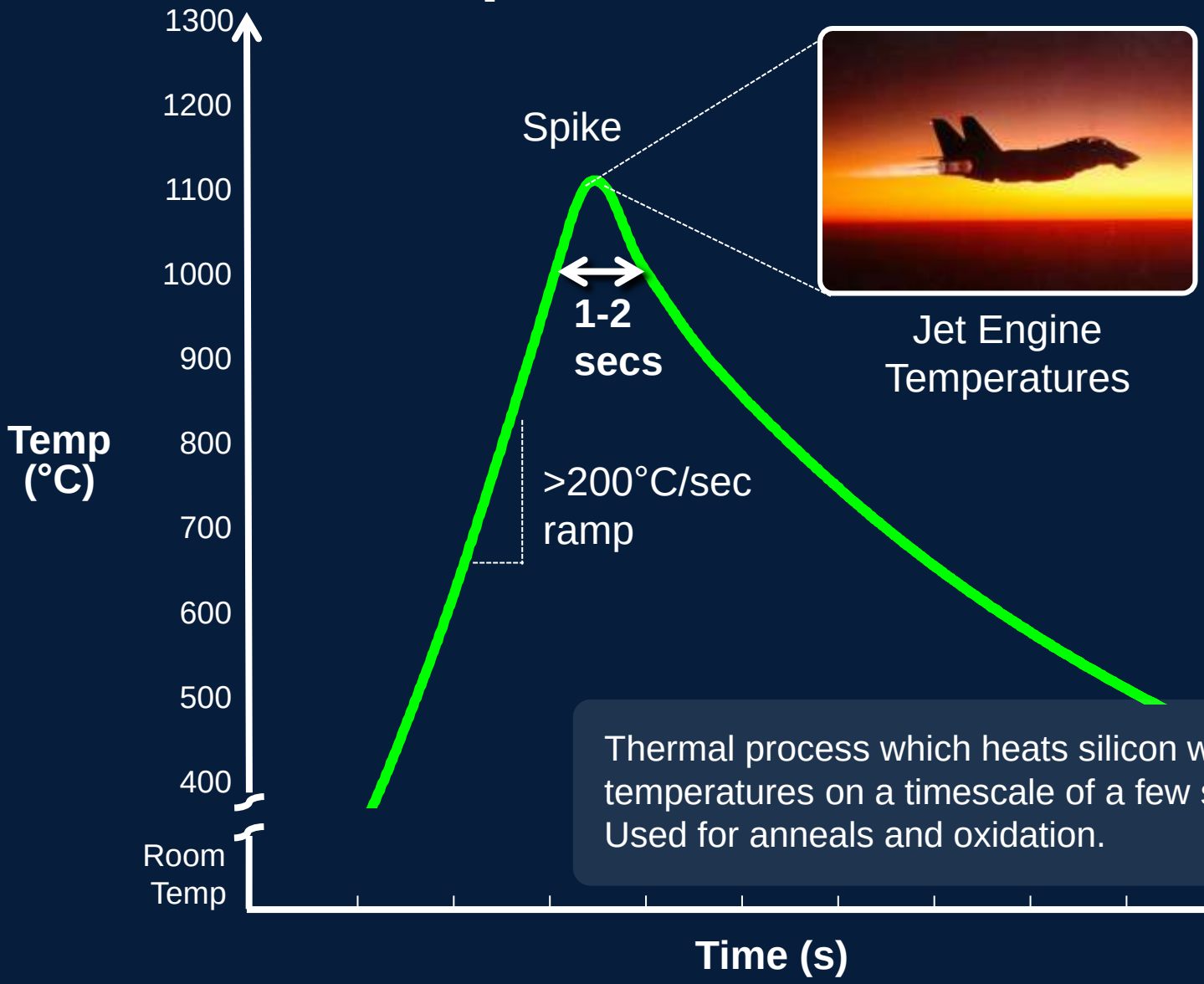
Mobility and Connectivity Driving Growth in Lower Power, High Performance Chips

Innovations Enable Inflections

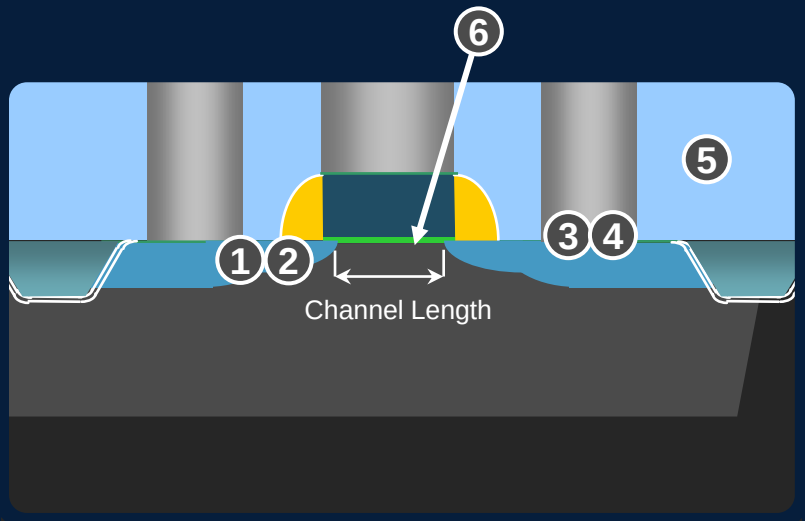
TRANSISTOR	INTERCONNECT	ADVANCED PATTERNING	WAFER-LEVEL PACKAGING
Vantage Vulcan™ RTP			
Reflexion GT™ for W			
Conforma™ Doping			
Avenir™ RF PVD Ni		Centris™ Etch	
Eterna™ FCVD	DFinder™ Inspection	Tetra™ X	Silvia™ Etch
Avenir™ RF PVD Gate	Raider® GT	Aera3™	Avila™ CVD
Siconi™ for Epi	Centinel™ PVD / ALD	Mesa™ Etch	InVia™ CVD
Astra™ DSA	Reflexion GT™ for Cu	UVision® 4 Brightfield	Raider S™ ECD

What is Rapid Thermal Processing?

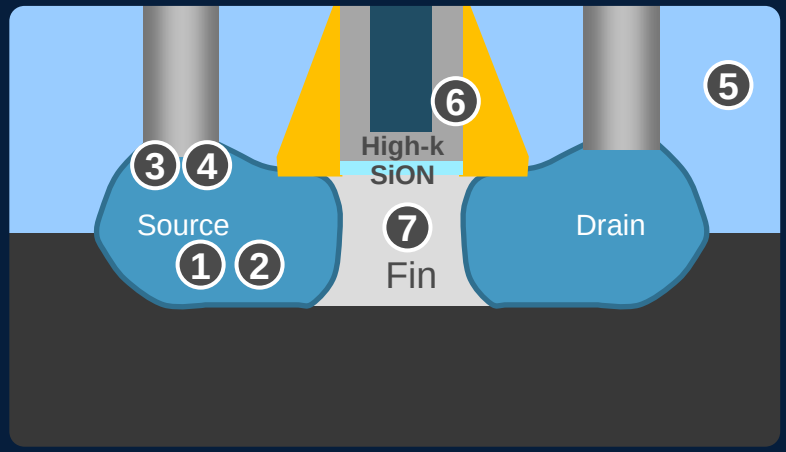


Thermal process which heats silicon wafers to ultra-high temperatures on a timescale of a few seconds.
Used for anneals and oxidation.

Multiple RTP Steps in Advanced Transistors



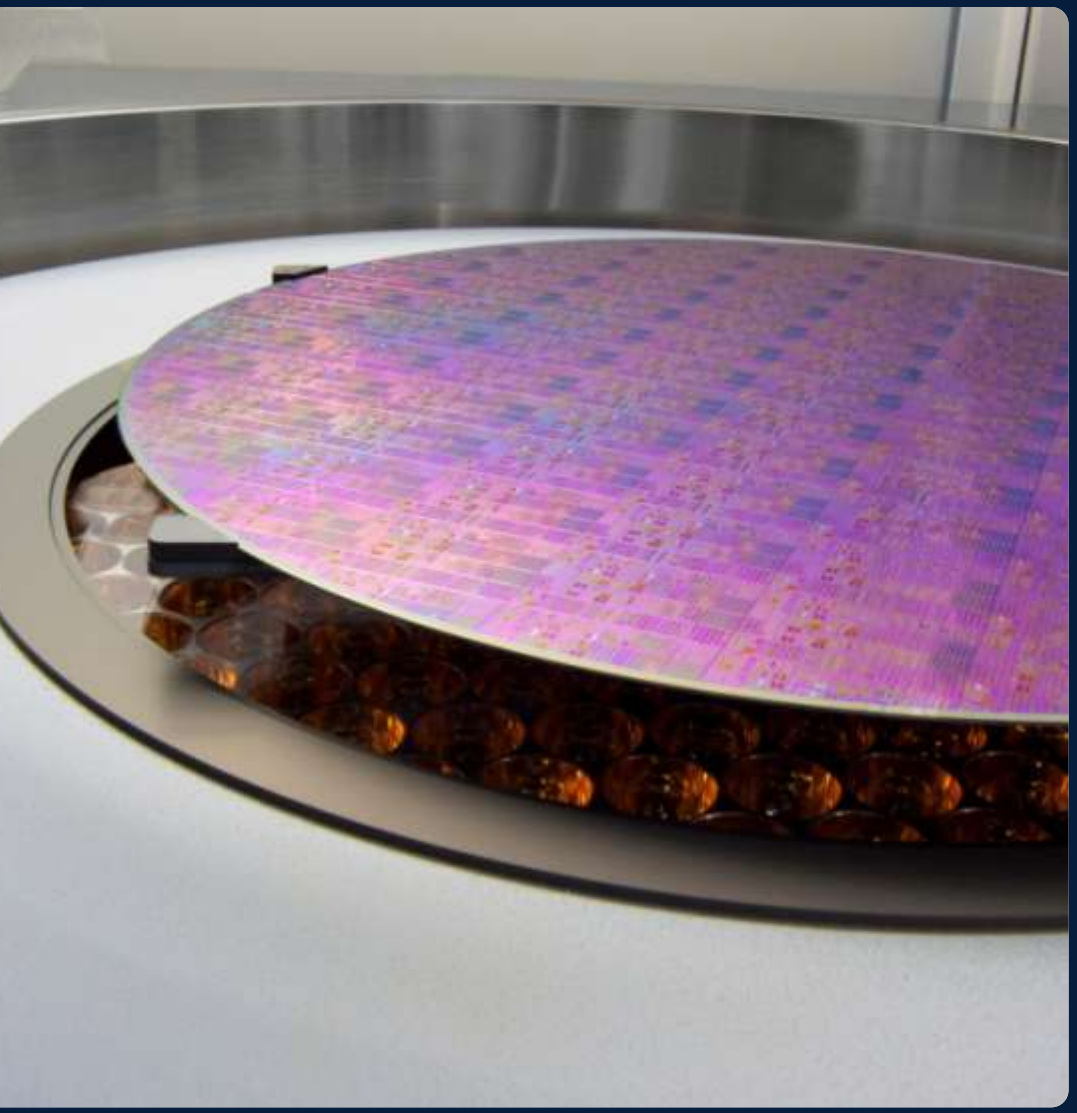
Advanced Planar Transistor



FinFET Transistor

1 2	Source/Drain Anneals
3 4	Silicide Anneals
5	Inter-Layer Dielectric Anneal
6	High-k Densification Anneal
7	Fin Implant Anneal

Introducing Applied Vantage Vulcan RTP

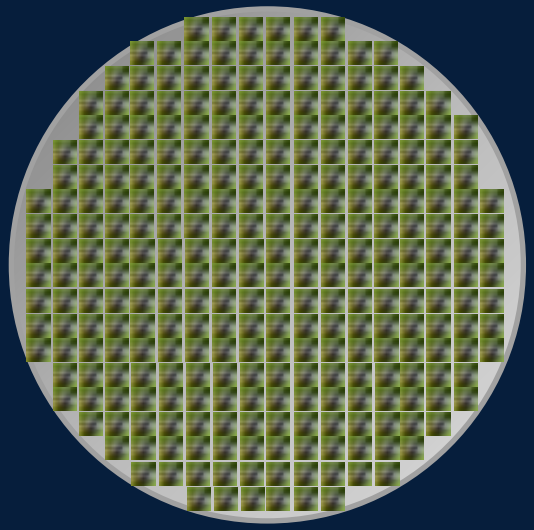


Revolutionary backside heating design

Extends Applied's technology leadership in ~$500M market

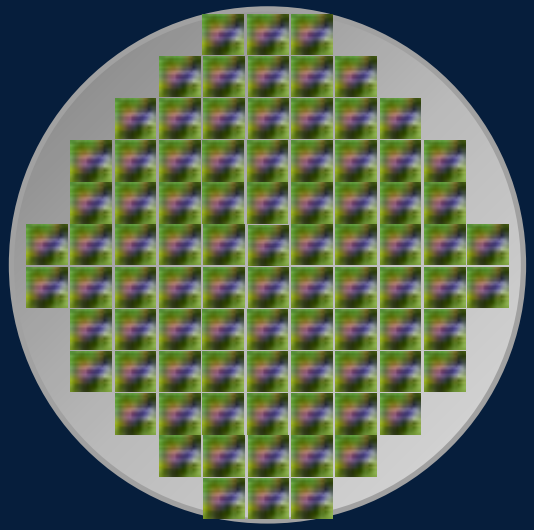
Source: Gartner Dataquest April '11

Challenge #1: Bigger Die Increase the Within-Die Uniformity Challenge



~150 mm² die

130nm
technology node
graphics chip



~500 mm² die

40nm
technology node
graphics chip

Less Margin For Error

Source: NVIDIA

Challenge #2: Temperature Micro-Climates Add Within-Die Variation

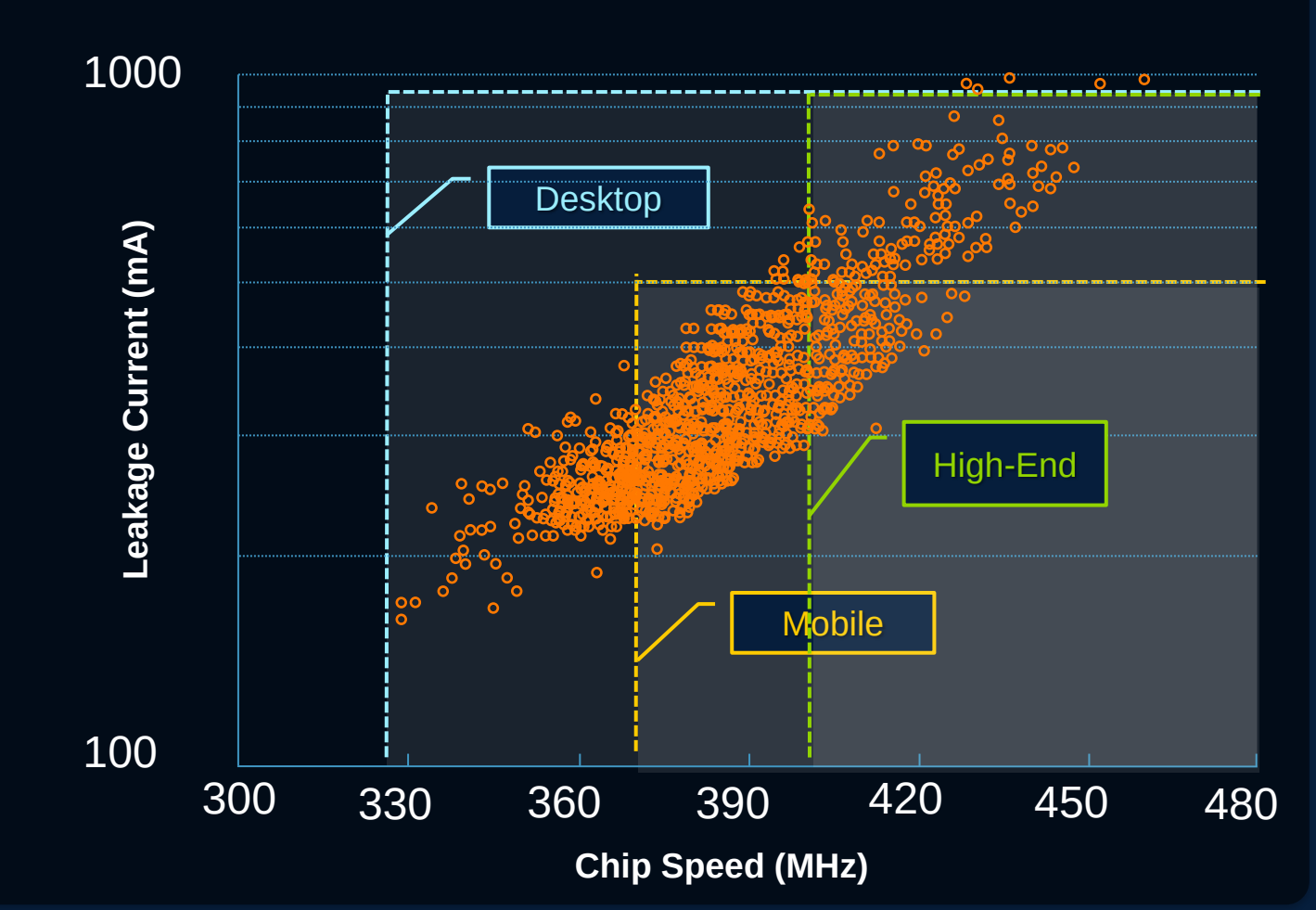
Dense City

32°C

Open Field

25°C

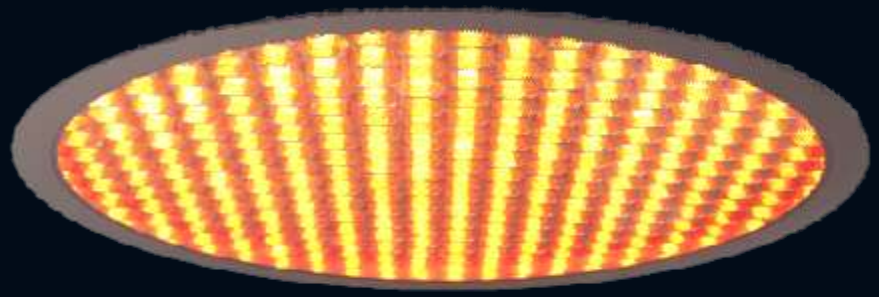
Customers Currently Change Design Rules to Combat This Effect



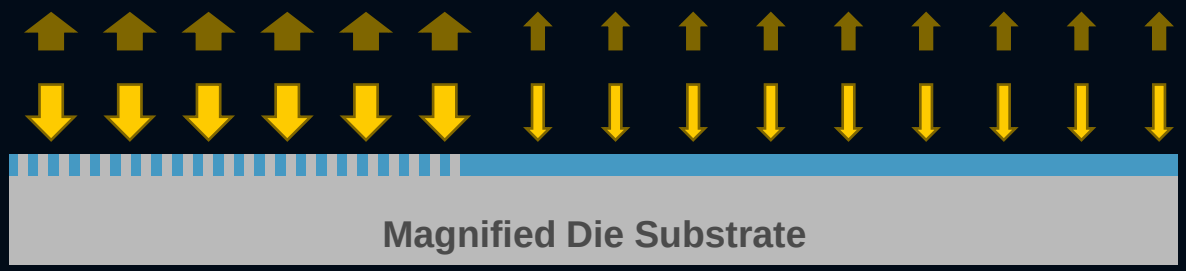
Graphics chips are binned for different end markets

Process Variability Can Result in Too Many Desktop Chips

Source: 2009 IEEE Keynote, J. Chen, NVIDIA



FRONTSIDE HEATING



Dense City

~9°C

Within-Die Difference

Open Field

Within-Die Spike Anneal Thermal Variability With Frontside Heating

APPLIED MATERIALS®

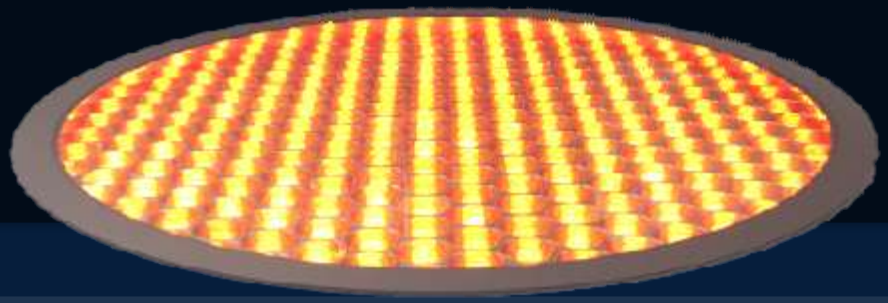
Dense City

<3°C

Within-Die Difference

Open Field

Uniform Absorbed and Emitted Energy

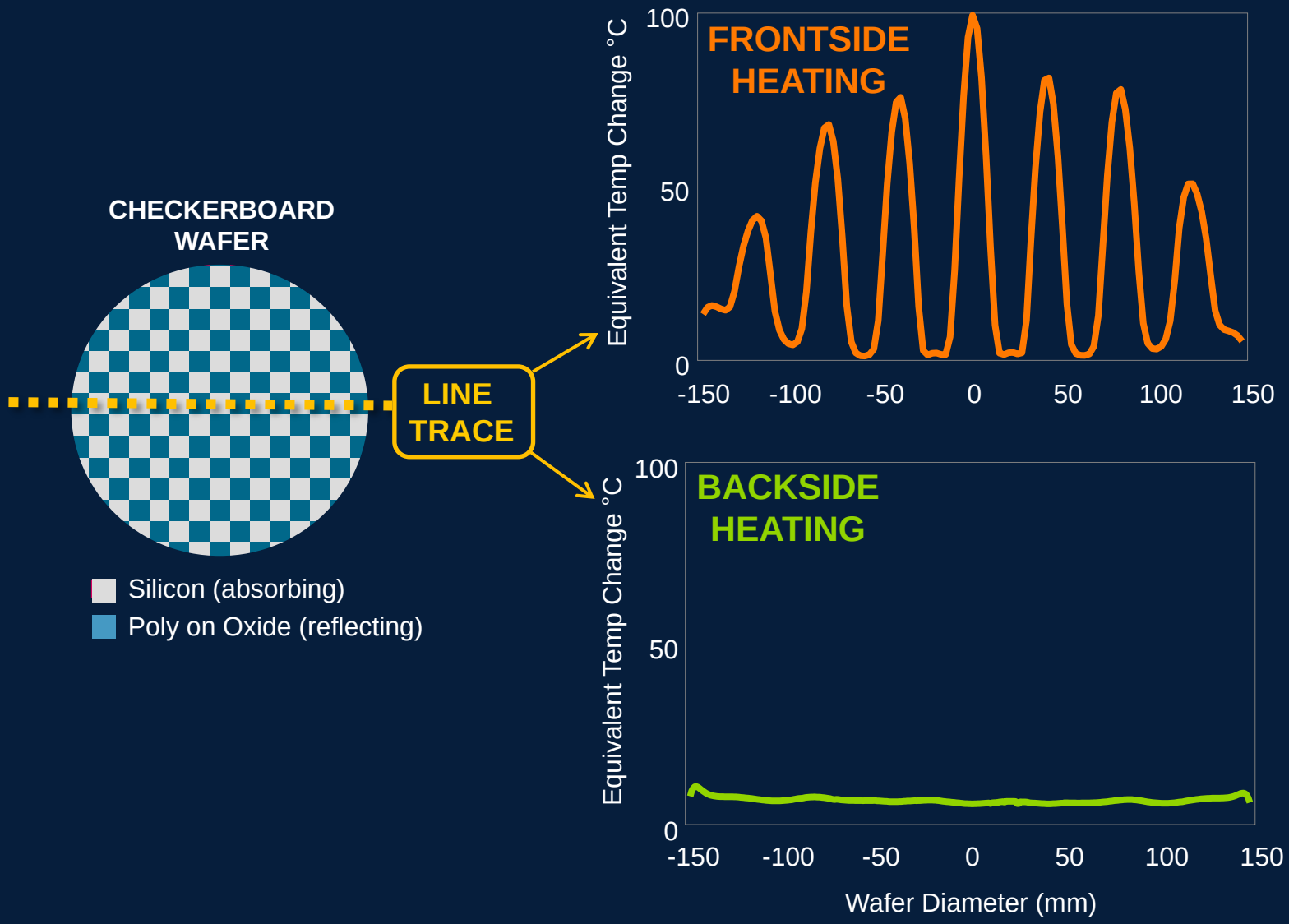


BACKSIDE HEATING

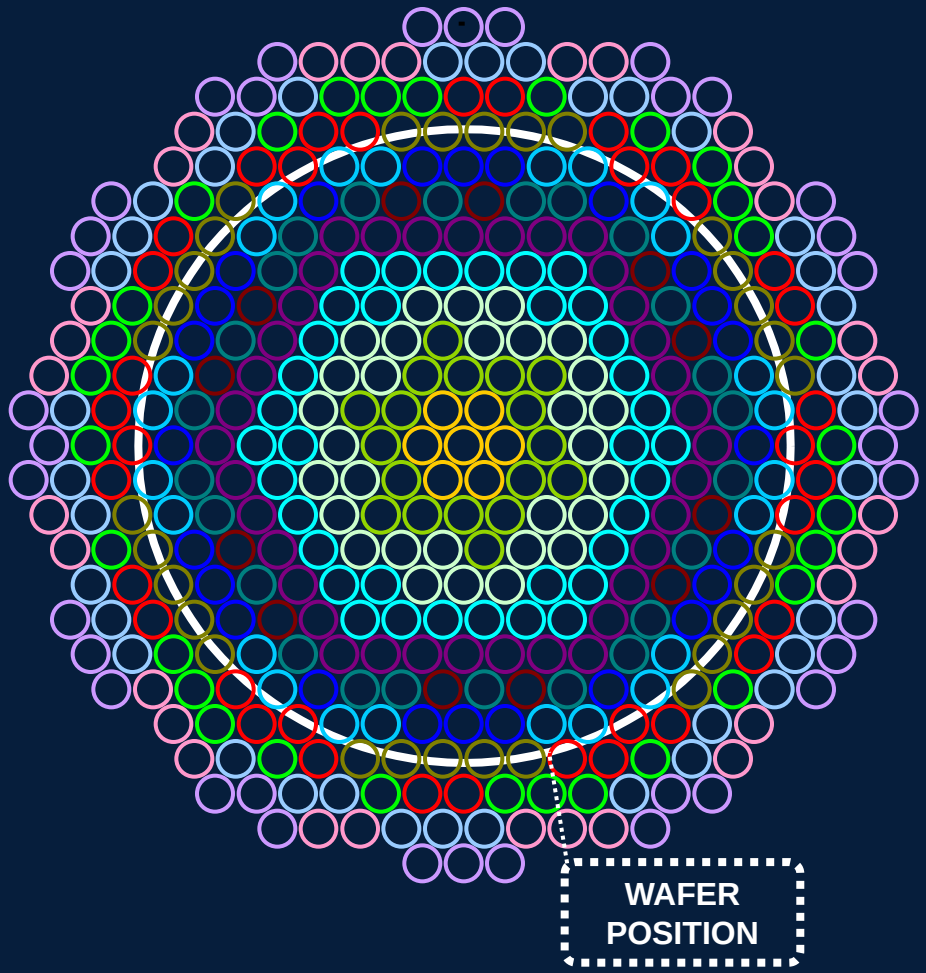
3X Decrease in Within-Die Thermal Variability With Vulcan System's Backside Heating

APPLIED MATERIALS®

Extreme Test For Within-Die Uniformity



Best-in-Class Dynamic Temperature Control



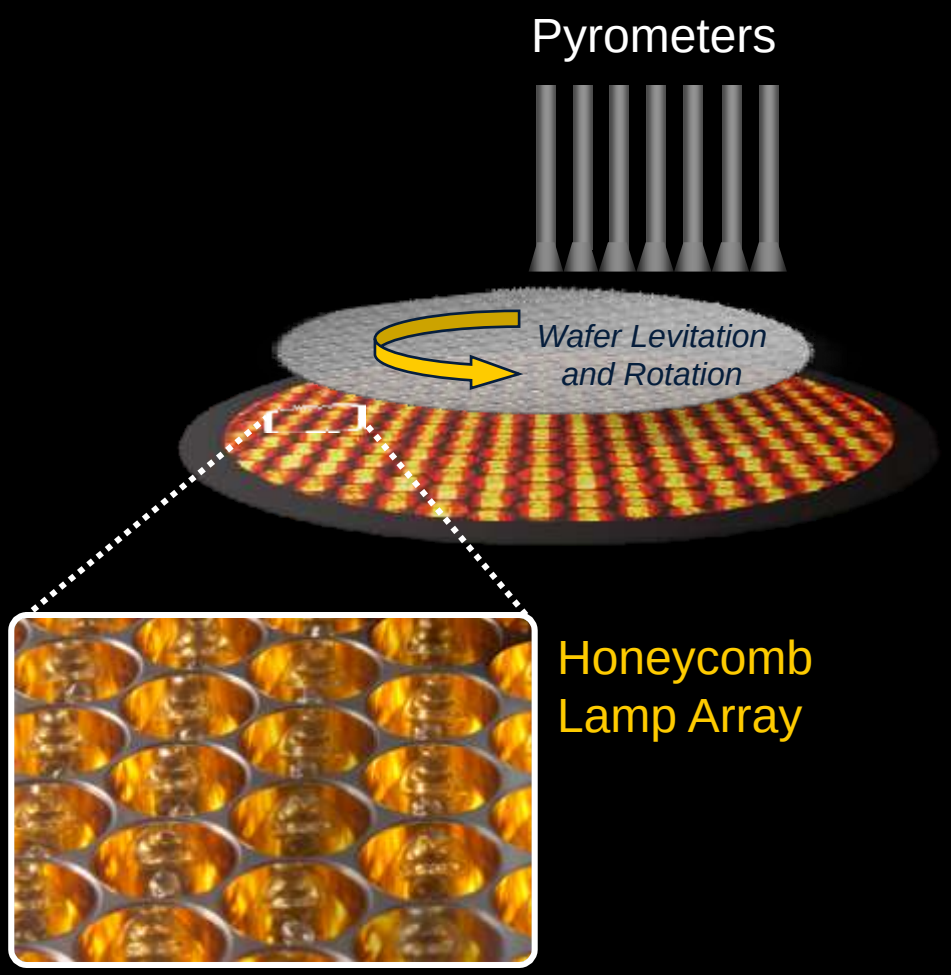
Proven honeycomb design with 18 zones

0.1% control of peak temperature

100 cycles-per-second multi-zone control

APPLIED MATERIALS®

Best-in-Class Dynamic Temperature Control

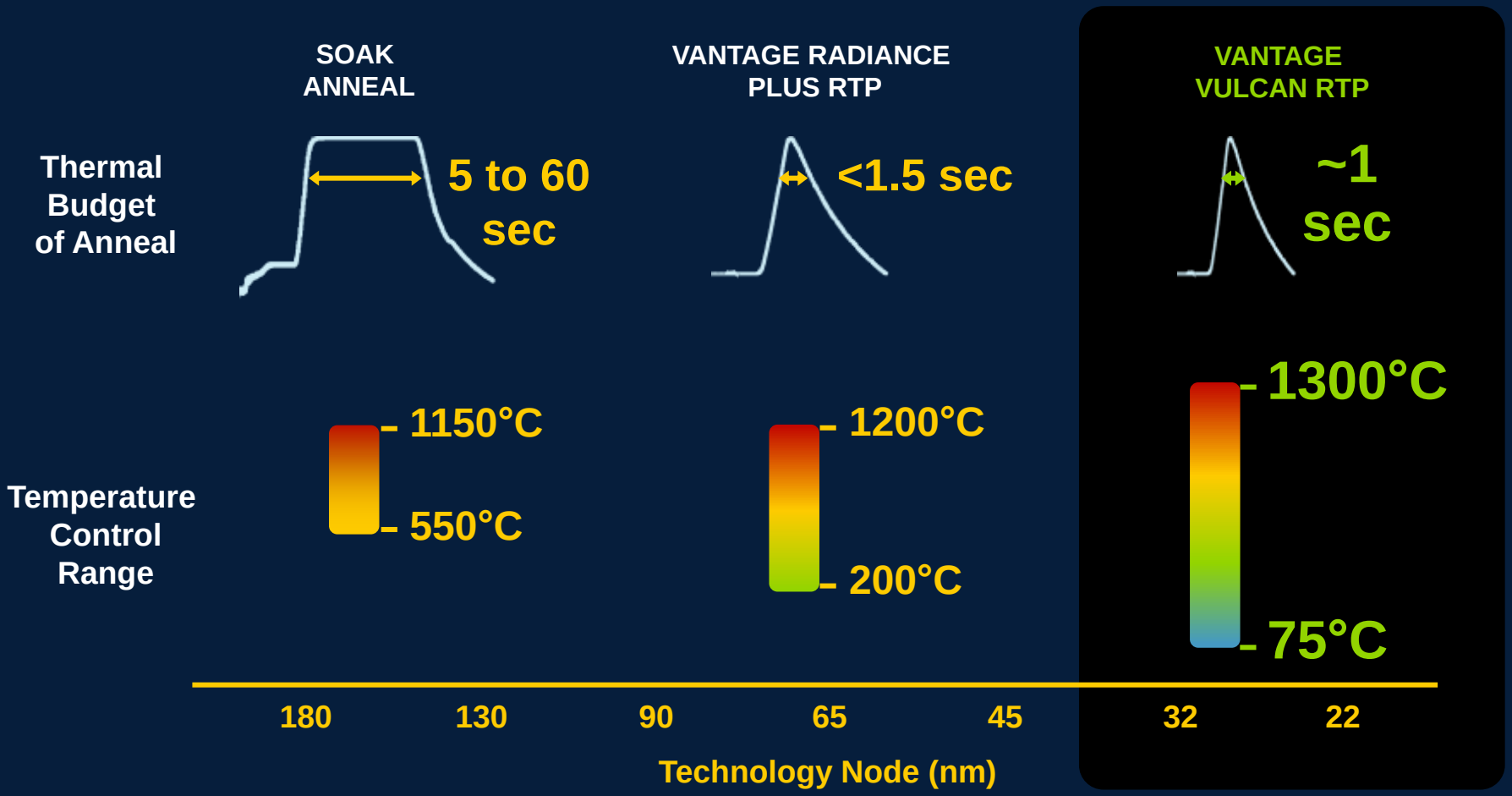


Proven honeycomb design with 18 zones

0.1% control of peak temperature

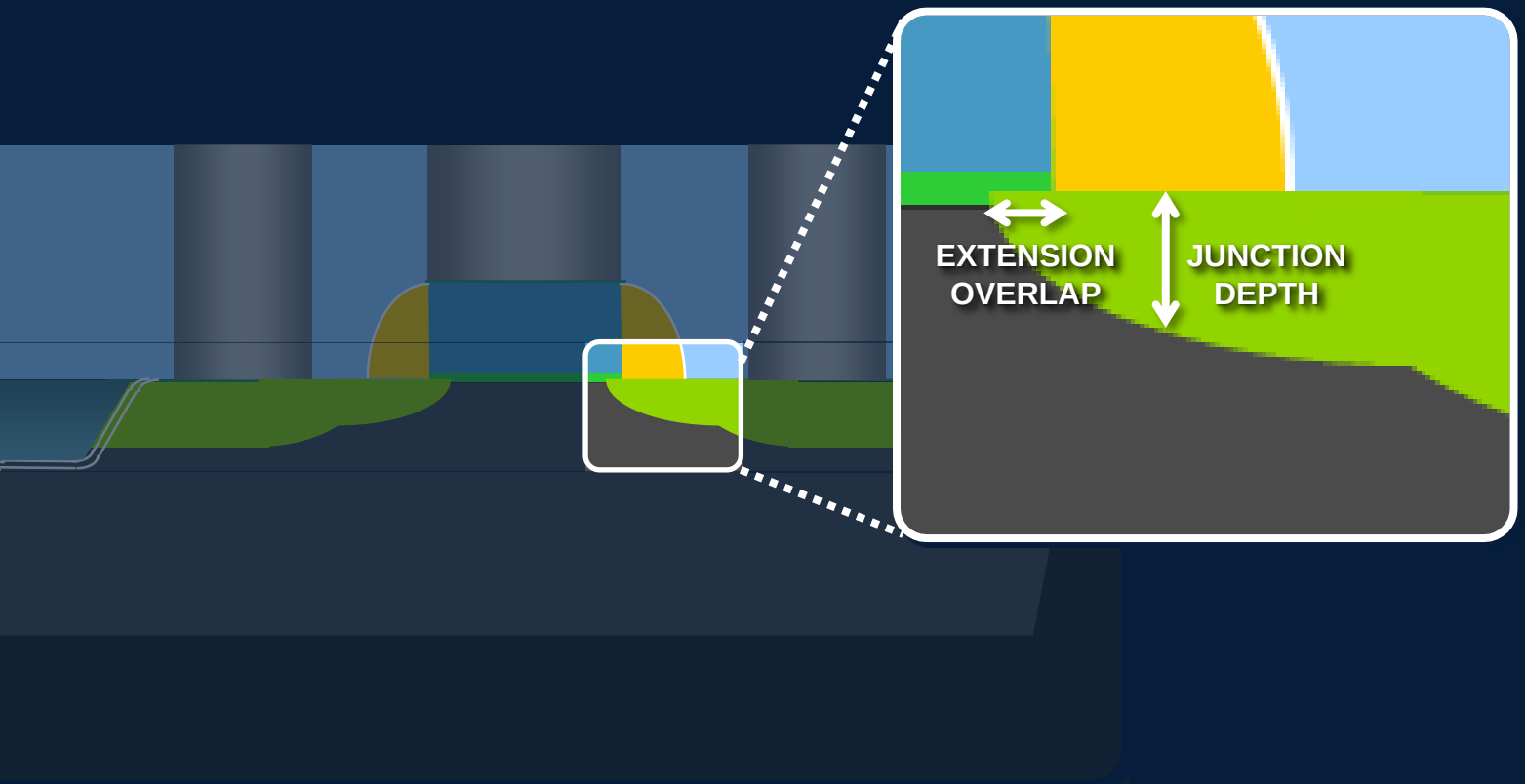
100 cycles-per-second multi-zone control

Thermal Processing Roadmap

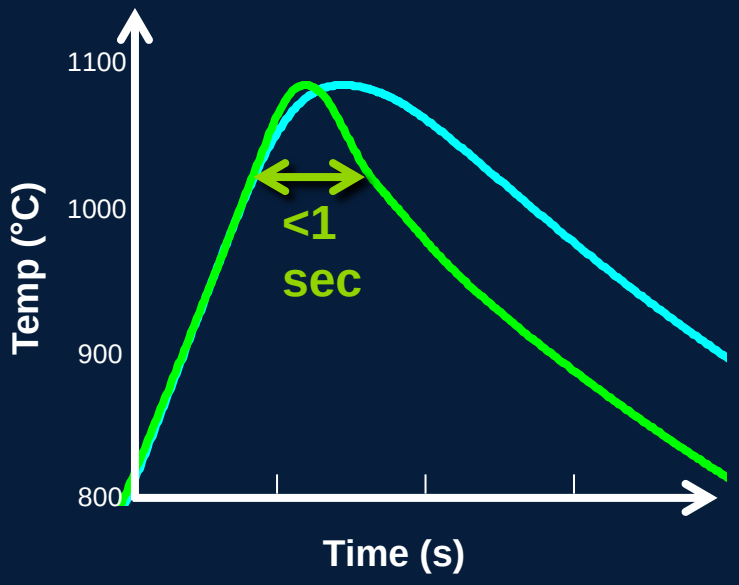


Enabling 28nm Node and Beyond With Sharper Spikes and Full-Range Temperature Control

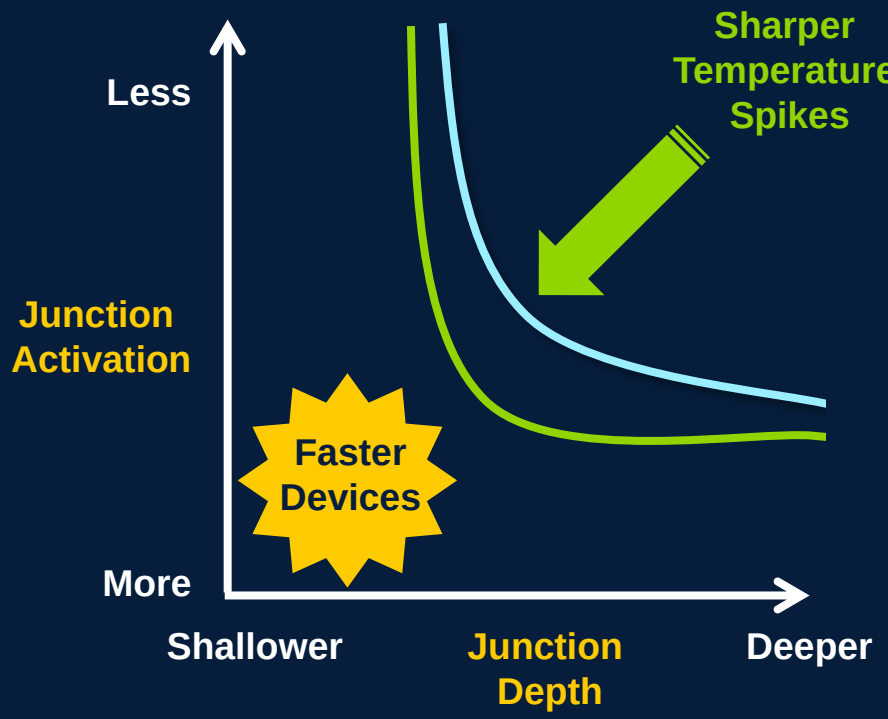
Atomic-Level Precision Required for Ultra-Shallow Junctions



Junction Diffusion Depth Must Be Reduced Without Compromising Activation

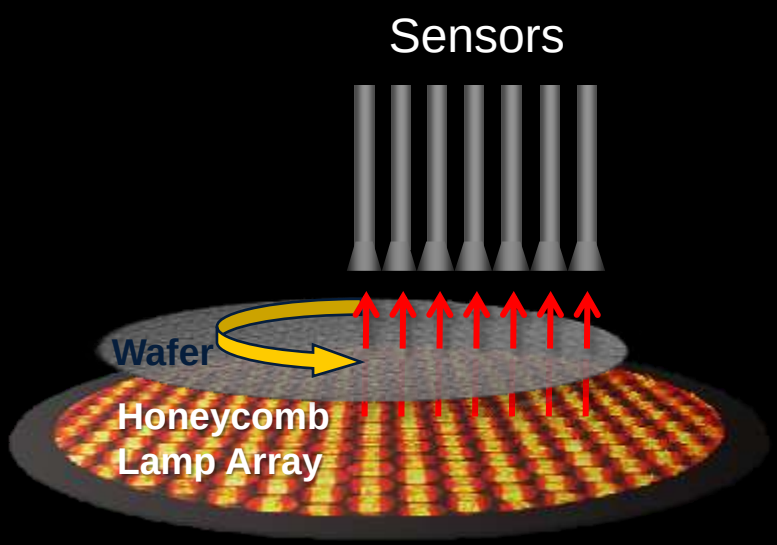


Vantage Vulcan Nearly Halves the Spike Residence Time



Faster Devices Through Sharper Temperature Ramp Profiles

Enabling Low-Temperature Regime Control



Closed-loop control from <75°C

Unique sensors for accurate, low-temperature measurement

New capability for advanced low-temperature applications

Industry's Greenest RTP Solution

CARBON FOOTPRINT REDUCTION* = 4 CARS OFF THE ROAD

Advanced system design improves usage of grid energy

* Per system; equivalent to 16 metric tons of CO_2/year

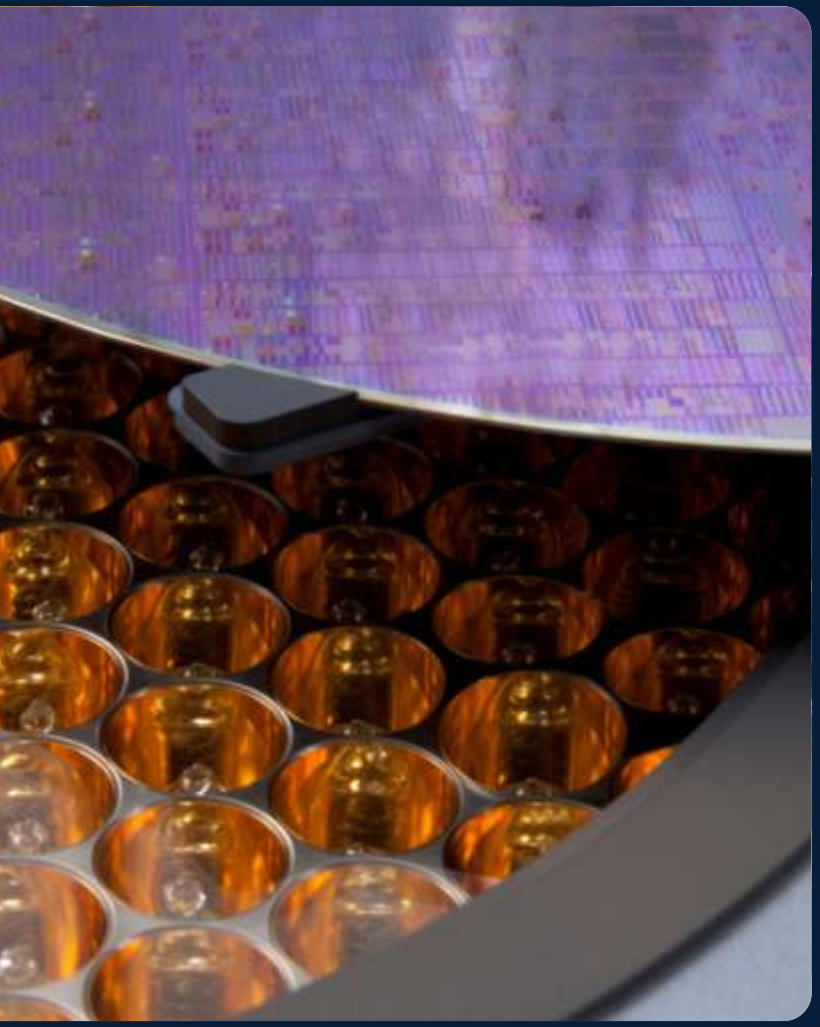
Applied's RTP is the Technology and Marketplace Leader

Vantage Radiance Plus	Vantage Vulcan
Tool of record at virtually every top chip maker	In place at top chip makers for spike anneal

RTP is a Growing ~$500M Market Opportunity

Applied Vantage Vulcan RTP

Continuing RTP Leadership for the Next Decade



Best-in-class temperature uniformity for higher yield

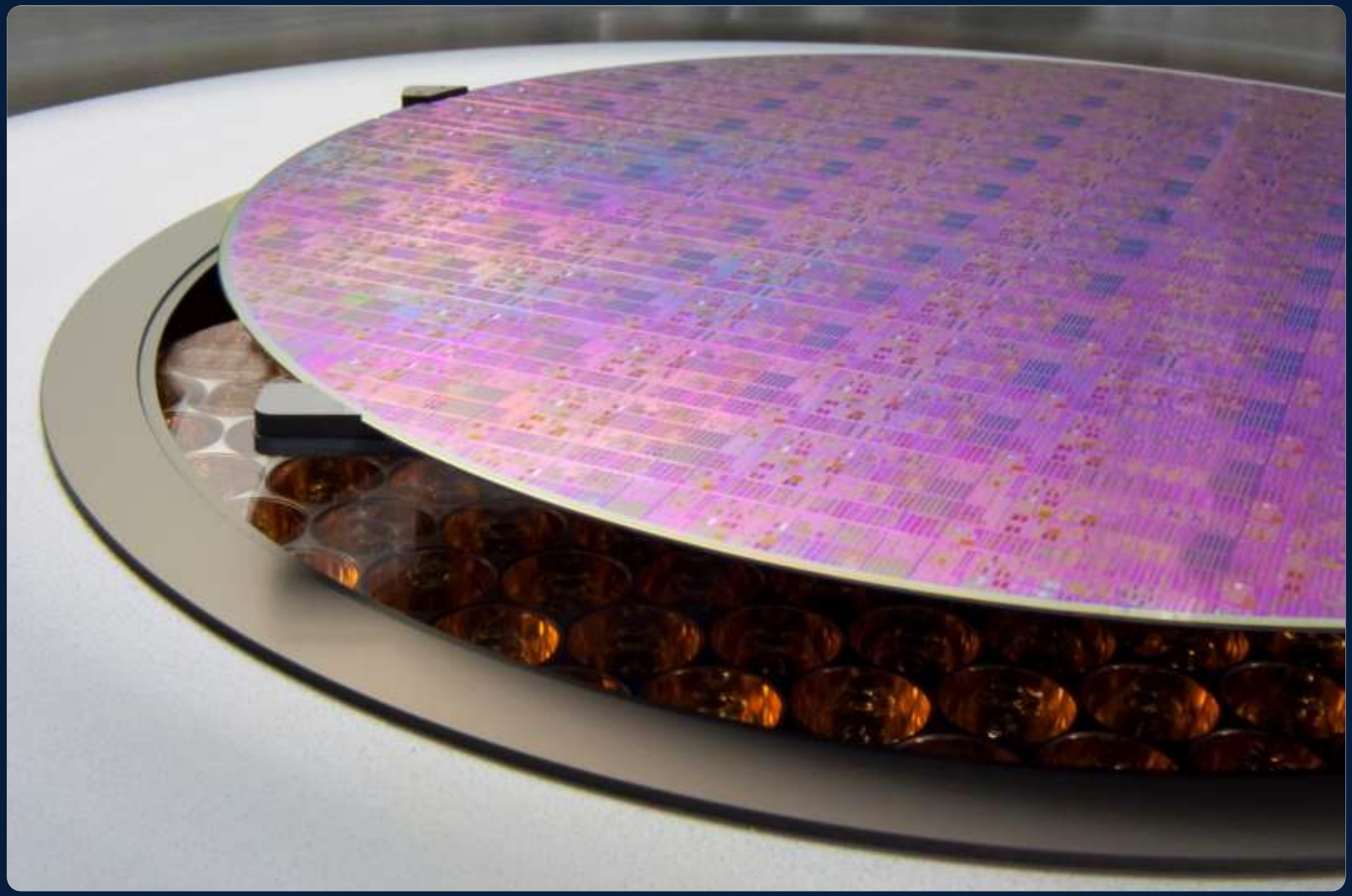
Sharper temperature spikes for faster chips

Low-temperature control for new applications

Efficient energy usage for lower carbon footprint

Applied Vantage Vulcan RTP

The Better Side of Anneal



Turning innovations
into industries.™