

HARDWARE

The Heat Wall

Why the best heat conductor on Earth is about to wrap your chips. Diamond, explained.



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Chips Are Not Transistor-Limited

They Are Heat-Limited

Give a modern AI GPU **more power** and it does not run faster. It throttles. The heat has nowhere to go fast enough. The ceiling stopped being lithography. It became **thermodynamics**.



Why Diamond

Thermal conductivity, watts per meter-kelvin

Diamond

2200

Silicon
Carbide

400

Copper

400

Silicon

150

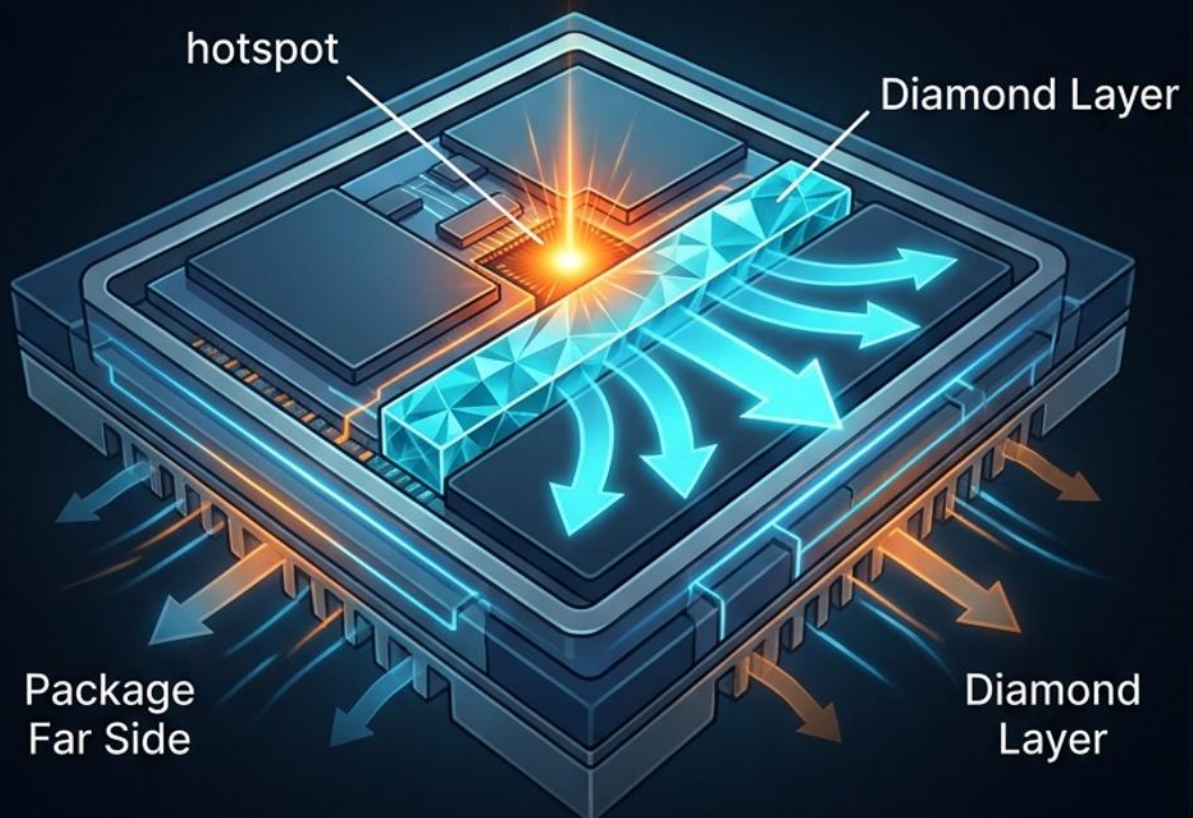
**5x faster
than copper**

And it is a near-perfect electrical insulator.
Nothing else does both.

Cool the Hotspot, Not the Street

The heat is born in a layer a few atoms thick, right at the transistor channel. Cooling the far side of the package is like air-conditioning the street to cool your bedroom.

Near-junction cooling puts diamond within nanometers of the hotspot.

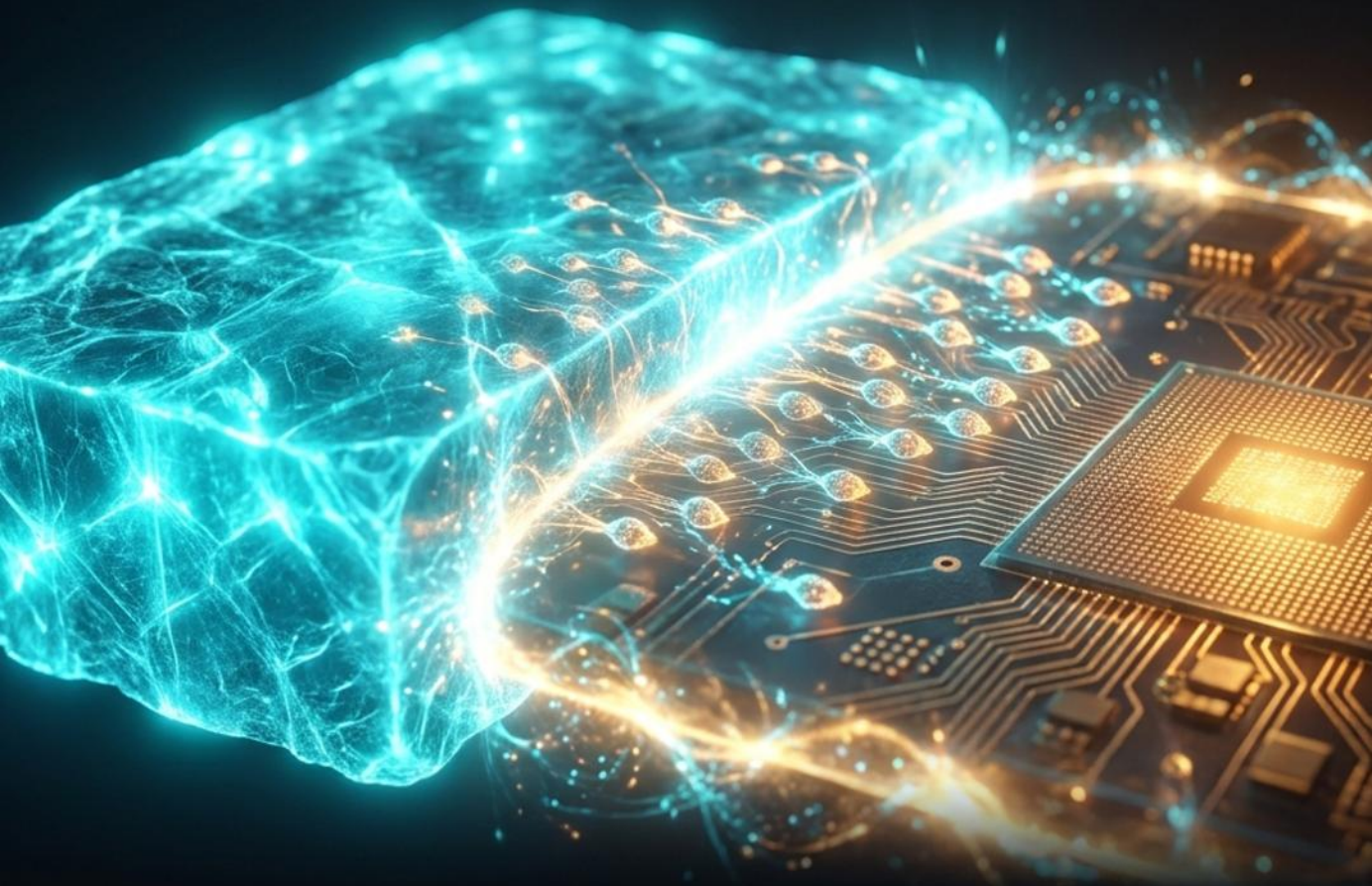


The Real Battle Is the Seam

Diamond's conductivity was never the hard part. The bottleneck is thermal boundary resistance, the microscopic seam where diamond meets the chip.

51 → 3.1

Boundary resistance, in m2K/GW. A 10x improvement, achieved with diamond 1 nanometer from the channel.



Proven: RF Gallium Nitride

Peer-reviewed, already heading into radar

100 c

peak device **temperature drop**
(Stanford + UCSB, 2025)



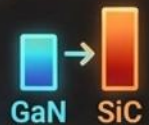
42 W/mm

output power at 8 GHz,
~30% above the prior record



50 to 70 c

channel **temperature cut** vs silicon carbide



Claimed: The Data Center

Vendor numbers, not yet independently benchmarked

Diamond Foundry:

52 C hotspot cut, **3 to 5x more power** into a Hopper-class GPU



Akash Systems:

+22% FLOPs per watt, peak performance up to **50 C** ambient



beat copper by

15+ C

Coherent:
diamond-SiC cold plates
beat copper by **15+ C**



⚠ Read 3 to 5x as a target, not a result.

Who Is Building It



Akash Systems

diamond-cooled GPU servers,
satellite radio in orbit



Diamond Foundry

first 100mm single-crystal
diamond wafer



Element Six (De Beers) + Orbray

50mm single-crystal wafers



Coherent

diamond-silicon-carbide cold plates



Raytheon + DARPA

GaN-on-diamond radar



Bristol, Georgia Tech, Stanford, UCSB

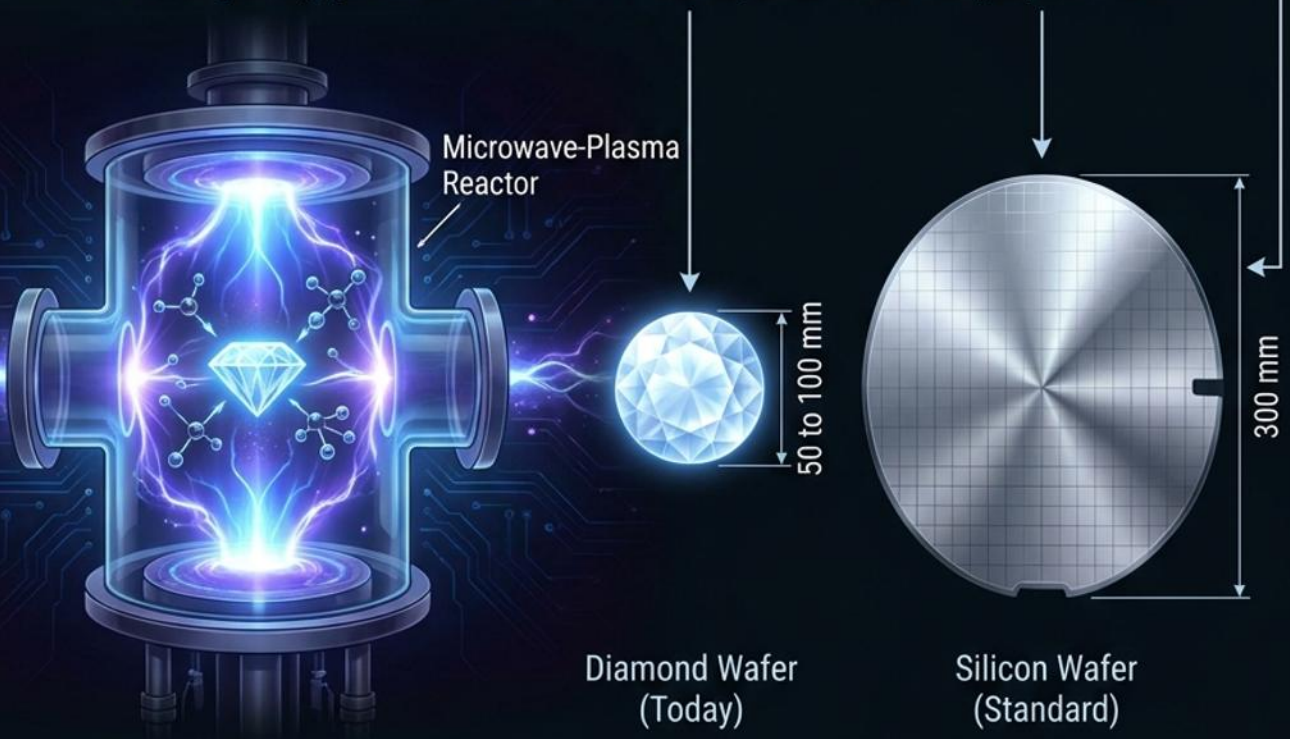
the science

How It Is Made, and the Wall

Diamond is grown, not mined, in a microwave-plasma reactor, atom by atom. It is either grown straight onto the chip or bonded on afterward.

50 to 100 mm vs 300 mm

Diamond wafer size today vs the silicon industry standard. Is the gating problem. Until it closes, diamond stays premium.



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The next decade of chips will be won in heat, not just lithography.



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