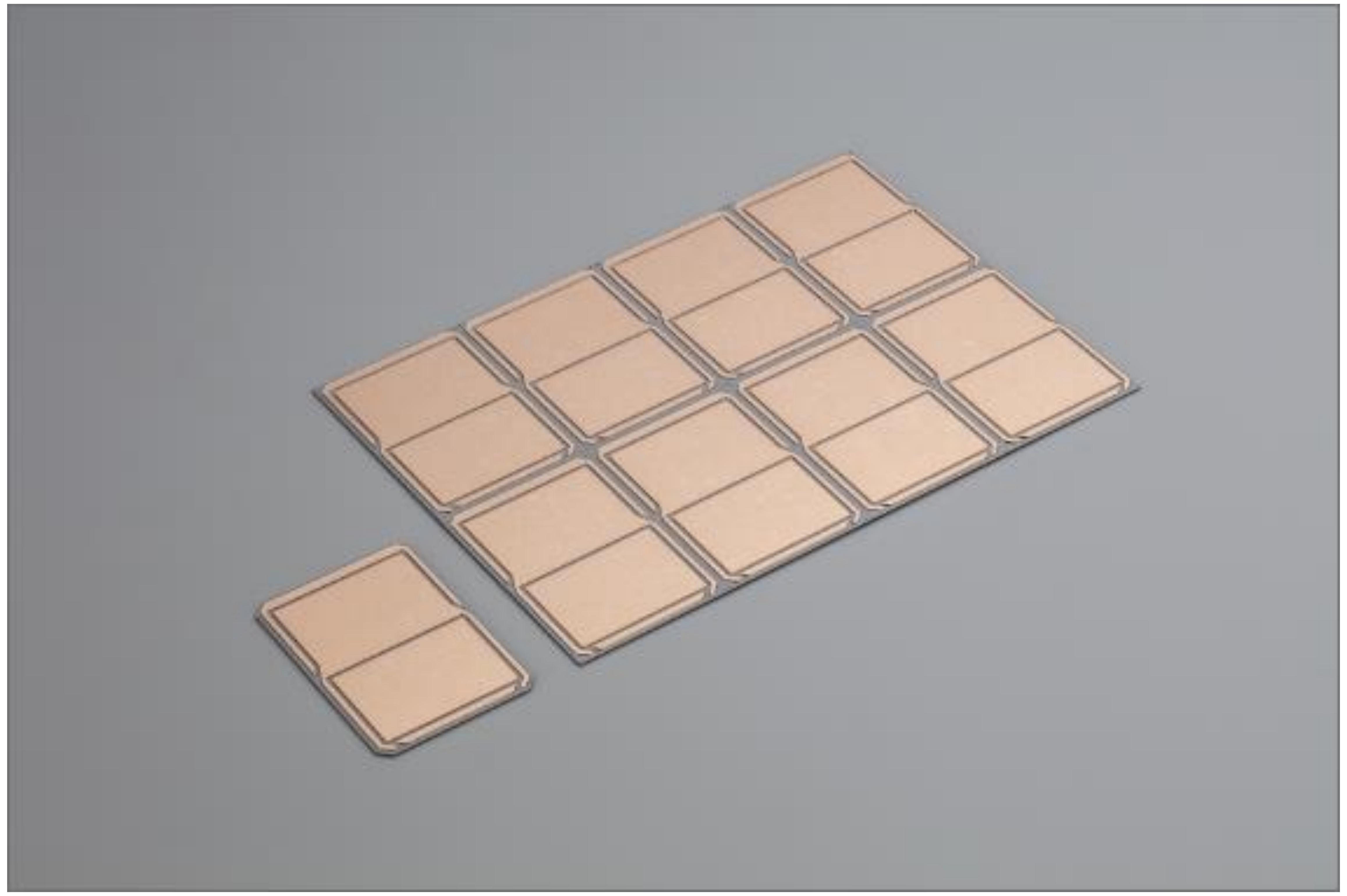
AMB and DCB Substrates for Power Modules / Power semiconductors

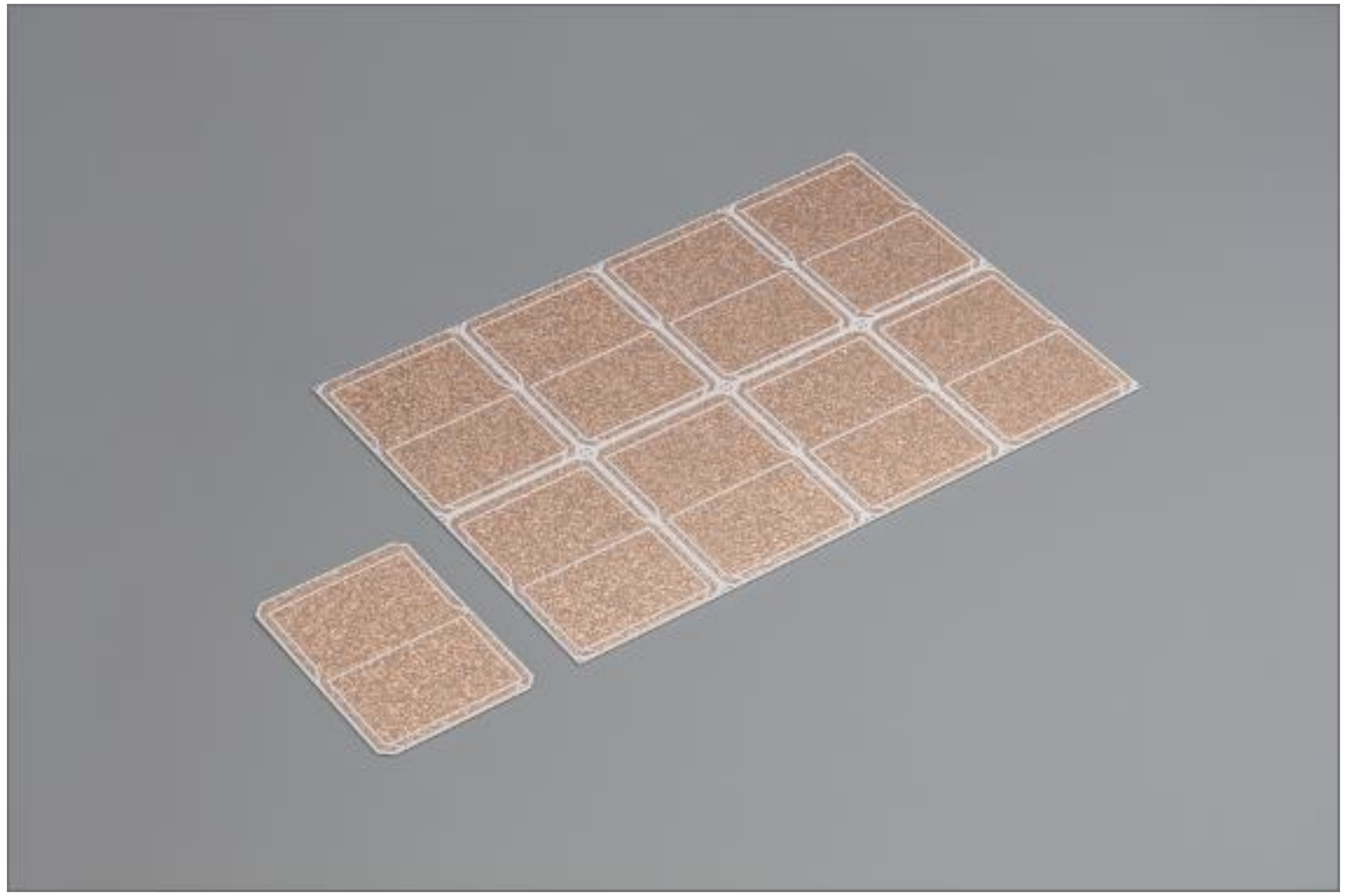
✓ NGK's Active Metal Brazing (AMB) substrates are based on silicon nitride (Si_3N_4) ceramic. In the AMB method we conduct, a bonding layer with a thickness of several micron or less has been achieved, producing almost no influence of the thermal resistance of the bonding layer, and superior thermal-cycle durability and isolation reliability.

✓ NGK's Direct Copper Bonding (DCB) substrates are based on both 96%-Al_2O_3 and ZDA (ZrO_2(10% - <20%) doped alumina(*)) bare ceramic substrates, directly bonded with copper on both sides – through a single step bonding process.

((*) NGK's patented ZDA materials)



Active Metal Brazing (AMB)



Direct Copper Bonding (DCB)

https://www.ngked.co.jp/en/product/dcb/index.html

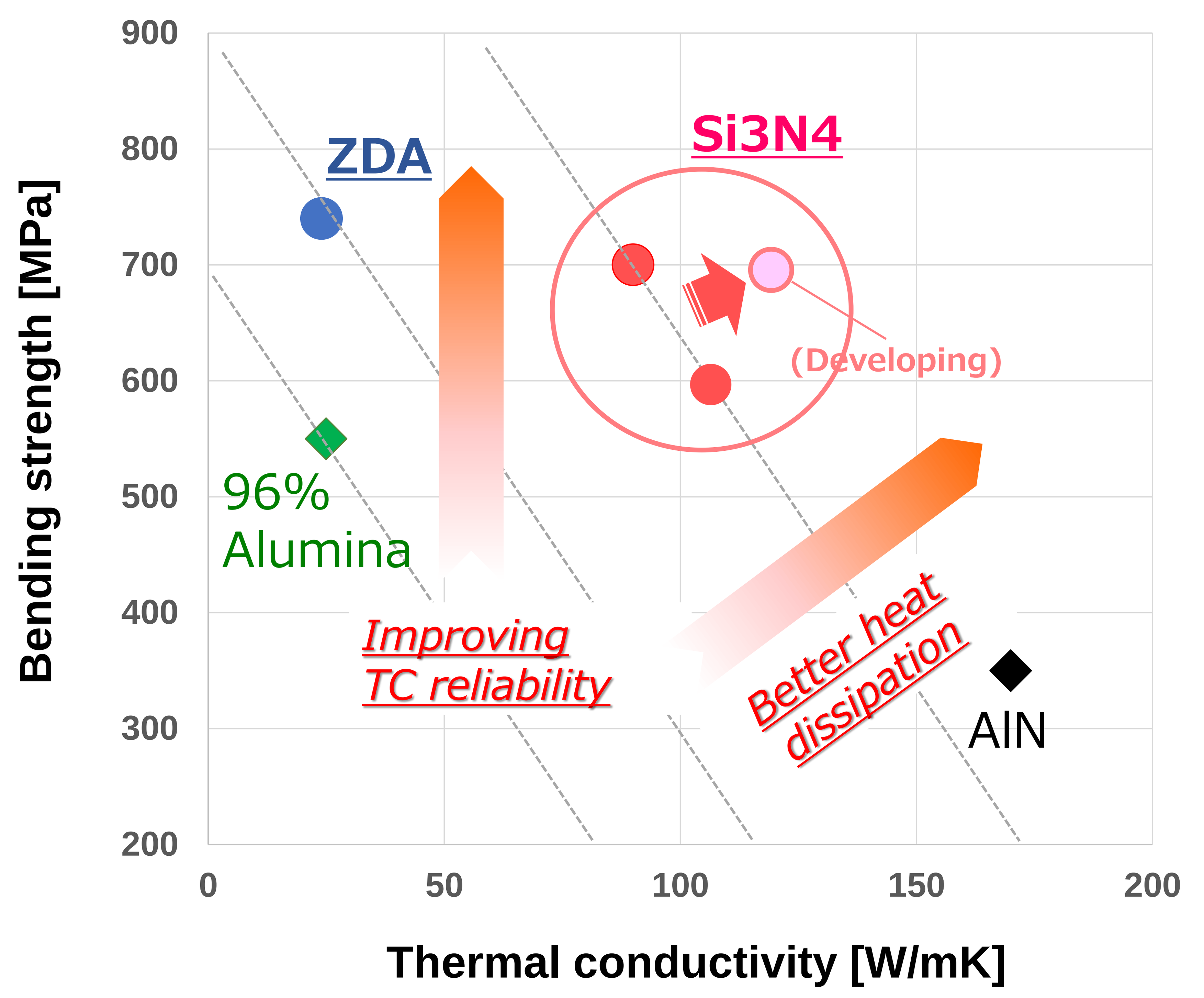
Applications / AMB and DCB substrate for Power Modules

A ceramic circuit board that combines the high heat dissipation properties of copper with the insulation performance ceramics. These products provide excellent reliability and heat conduction, and are used in the power modules that perform motor drive control and power conversion control for generators. In addition to the electrification of automobiles [Electric Vehicle / Hybrid Electric Vehicle], NGK also forecast increased demand for renewable energy and other industrial equipment applications.

Features / NGK's High Reliability AMB and DCB Ceramic Substrate

General characteristic of NGK's ceramic materials (typical values)

General characteristics	Ceramics materials					Ref.
	DCB		Si_3N_4-AMB			
	96% Alumina NAT-319	ZDA (Patent) NAT-325	90W/mK	110W/mK	≧120W/mK	AlN
Thermal conductivity (W/mK)	25	25	80-90	100-110	(120)	170
Bending strength (MPa)	550	750	700	600	(700)	350
Fracture toughness (MPa $m^{1/2}$)	3.2	4.4	6.0-7.0	5.5-6.5	(5.5-6.5)	3.0
Electrical Resistivity (Ωcm)	$>10^{14}$	$>10^{14}$	$>10^{14}$	$>10^{14}$	$>10^{14}$	$>10^{14}$
Remarks	-	-	Standard Si_3N_4	Higher thermal conductivity	**Under development	-



- ✓ AMB and DCB Substrates for Power Modules are products in which copper plates are bonded to each surface of a ceramic plate, which is an insulating material. NGK offer Silicon Nitride-based and Alumina-based ceramic materials.
- ✓ Through bonding by the AMB method and DCB method respectively, the Silicon Nitride-based ceramic plate and Alumina-based ceramic plate are integrated with the copper plate.
- ✓ Those products are characterized by a high thermal conductivity and a high electric conductivity of copper, and also a high insulation property of ceramic substrate. In the AMB method, a bonding layer with a thickness of several microns or less is achieved, the advantage being there is almost no effect on thermal resistance.
- ✓ In addition, as a copper plate is directly bonded to an alumina based ceramic substrate in the DCB method, there is no brazing layer that acts as thermal resistance

NGK's Surface Finishing Solutions

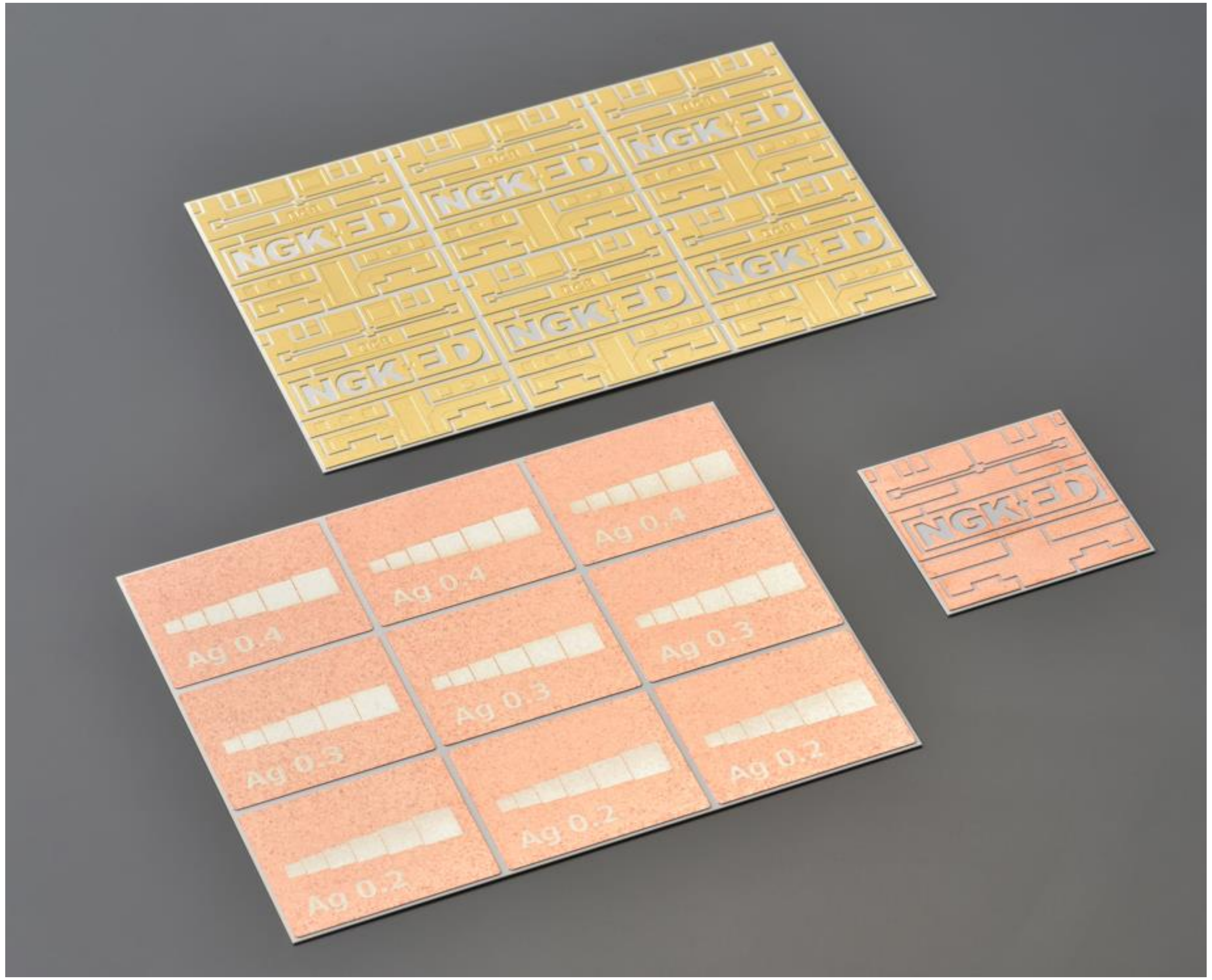
✓NGK provides following <u>surface finishing solutions depending on customer's design.</u>
(e.g. Plating, Step etching, Solder resist, Dimples, DMC)

✓Cu surface (No Plating)
✓Ni plating (Electroless)
✓Ag plating (Electroless)
✓Selective Ag plating (Electroless)
✓Step Etching
✓Narrow width groove
✓Solder resist

<u>Other options:</u>

✓DMC
→ For traceability

✓Dimples (front/back-side)
→ For improving TC reliability
(i) DCB: better to add for reliability
(ii) SiN-AMB: basically, no need to add



Contact NGK

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