

PBN/PG Ceramic Heaters

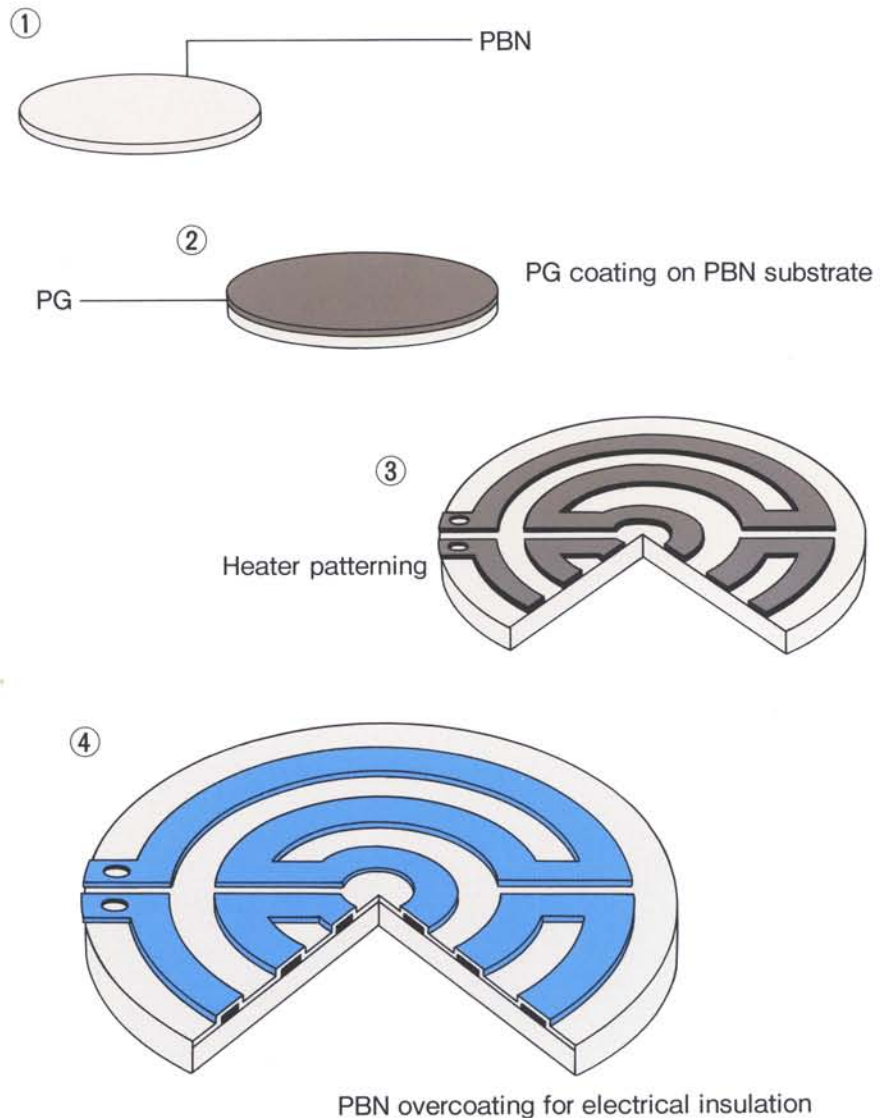


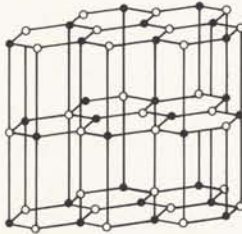
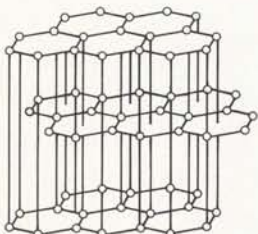
PBN/PG Ceramic Heaters

PBN/PG heaters combine three layers of ultra high purity ceramics, PBN-PG-PBN to produce an advanced heating element system. Both PBN (Pyrolytic Boron Nitride) and PG (Pyrolytic Graphite) are manufactured by high temperature CVD. These high performance elements exhibit outstanding thermal properties including high thermal conductivity and anisotropy.

◆ Structure and manufacturing process

The remarkable properties of PBN and PG have been combined by chemical vapor deposition as follows.



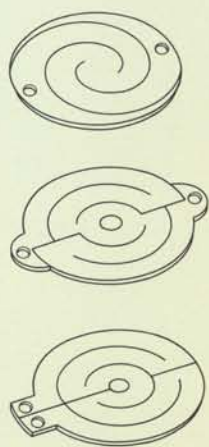
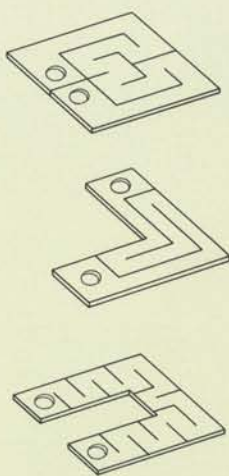
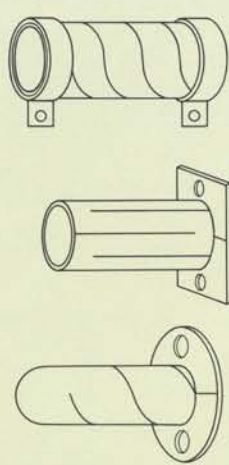
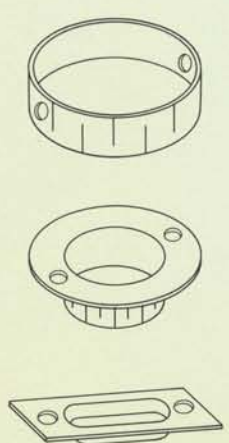
	PBN	PG
Process	CVD (High temperature) (Reduced pressure) $\text{BCl}_3 + \text{NH}_3 \rightarrow \text{BN} + 3\text{HCl}$	CVD (High temperature) (Reduced pressure) $\text{CH}_4 \rightarrow \text{C} + 2\text{H}_2$
Structure	 ● Boron ○ Nitrogen	 ○ Carbon
Properties		
● Purity (Total metal impurities)	< 1 ppm	< 1 ppm
● Maximum suggested use temperature	3000°C	3600°C
● Tensile strength at high temperature ("a" direction)		
r.t.	410kg/cm ²	1050kg/cm ²
2200°C	1030kg/cm ²	1400kg/cm ²
● Chemical inertness	○	○
● Thermal shock resistance	○	○
● Machinability	○	○
● Outgassing	Negligible	Negligible
● Resistivity		
"a" direction 1000°C	$3 \times 10^7 \Omega \text{cm}$	$4 \times 10^{-6} \Omega \text{cm}$
"c" direction 1000°C	$3 \times 10^9 \Omega \text{cm}$	$2 \times 10^{-3} \Omega \text{cm}$

◆ **PBN/PG Performance advantages.**

- ① Operating temperature to $\geq 1600^{\circ}\text{C}$.
- ② High mechanical durability and dimensional stability.
- ③ Dimensionally compact. PBN layer provides electrical insulation.
- ④ Thermal gradients can be tailored to meet specific requirements.
- ⑤ Eliminate outgassing and contaminations.
- ⑥ High thermal shock resistance.
- ⑦ Chemically inert to almost all metals, liquids, and gas.
- ⑧ Large variety of sizes and shapes available.



◆ Sizes and applications

	Wafer	Rectangle	Rod/Tube	Cup/Boat
Sizes (mm)	φ380 MAX 1.0~3.0 thickness	260×260 MAX 1.0~3.0 thickness	φ300 MAX 300 length MAX	φ300 MAX 200 height MAX
				
Appli- cations	• Semiconductor substrate heating (MBE, MOCVD, Sputtering, CVD) • Superconductor substrate heating • Sample heating during analysis • Sample for electron microscope heating		• Melt heating • Source heating during metal evaporation	

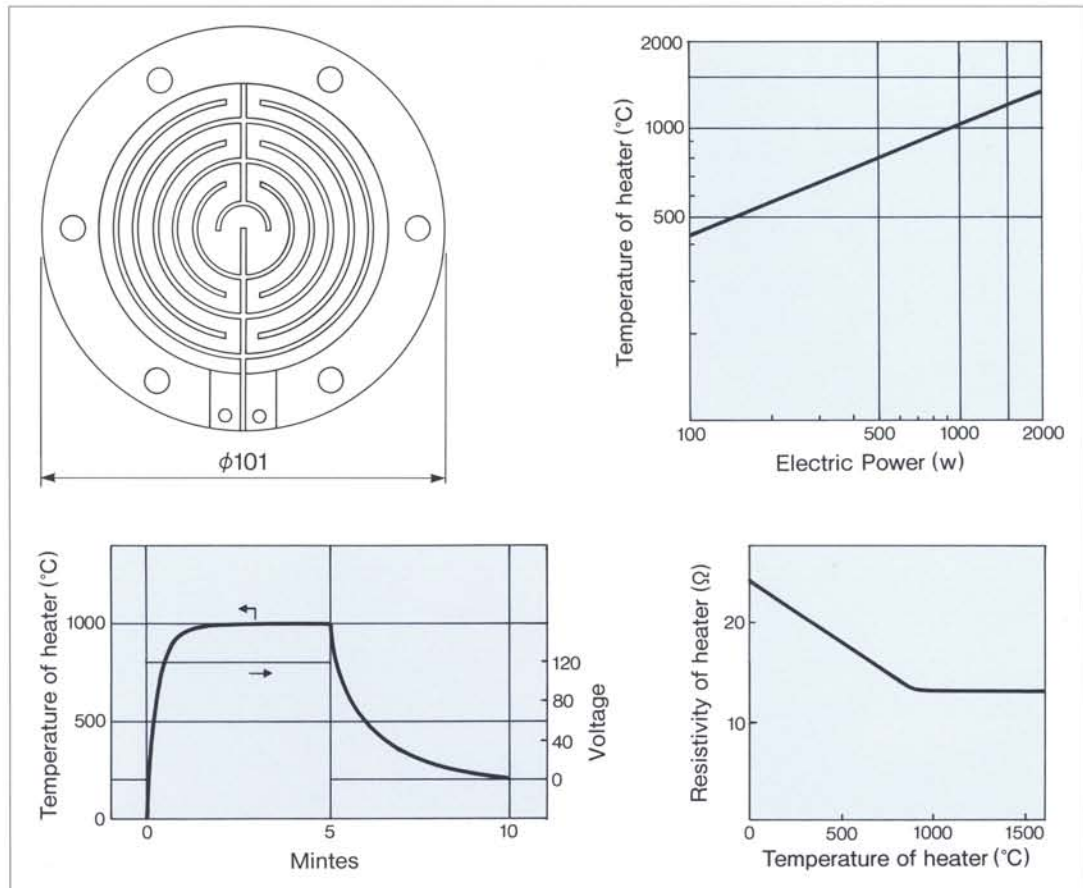
◆ Custom PBN/PG Heater Design

Required minimum information is as follows.

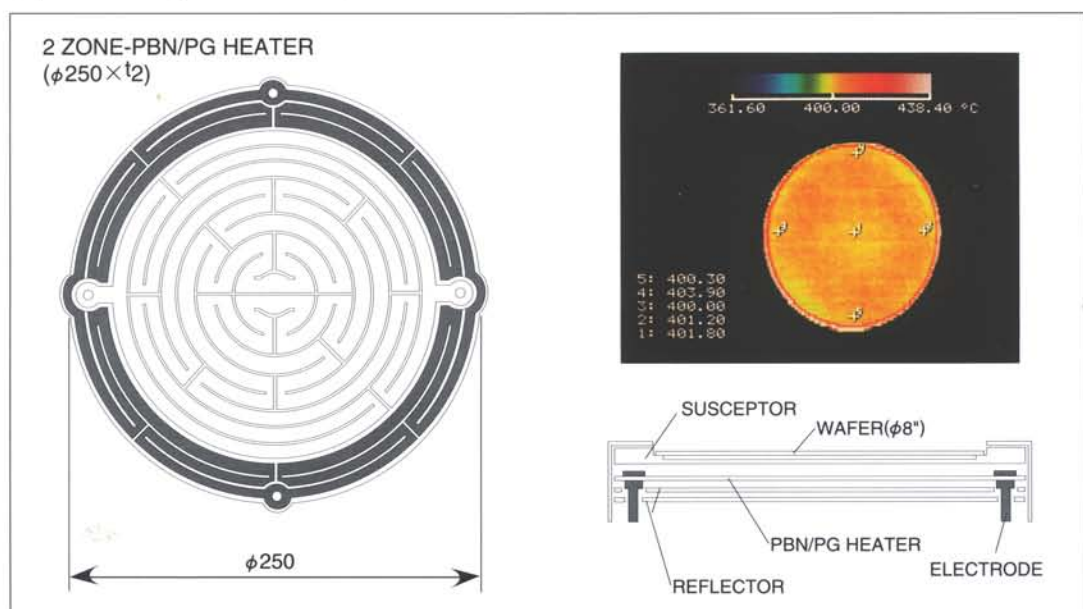
- ① Shape.....Size, structure of electrode.
- ② Temperature and thermal gradients of application.
- ③ Atmosphere of application.
- ④ Power source.

◆ Technical data

(1) Heating data of $\phi 4''$ heater



(2) Thermal gradients of $\phi 10''$ heater





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