

# News Release

October 3, 2023  
Proterial, Ltd.

## Silicon nitride substrates and circuit substrates with high insulation reliability Received the Tottori Prefectural Governor's Award at the Chugoku Region Invention Honors for FY 2023

Proterial, Ltd. (hereinafter referred to as "Proterial") and Proterial Ferrite Electronics, Ltd. (hereinafter referred to as "Proterial Ferrite Electronics") have been awarded the Tottori Prefectural Governor's Award at the Chugoku Region Invention Honors sponsored by the Japan Institute of Invention and Innovation for their "Silicon nitride substrates and circuit substrates with high insulation reliability" (Invented by Hisayuki Imamura, Suguru Fujita, Yoichiro Kaga, Hiroyuki Teshima, and Shigeyuki Hamayoshi). The award ceremony is scheduled to take place at Hotel Granvia Okayama on Tuesday, October 17.

### 1. Invention

Method for manufacturing circuit substrates and sintered silicon nitride substrate (Patent No. 6399252)

### 2. Awardees

Tottori Prefectural Governor's Award

Hisayuki Imamura, Proterial, Ltd.

Suguru Fujita, Proterial Ferrite Electronics, Ltd.

Yoichiro Kaga, Proterial Ferrite Electronics, Ltd.

Hiroyuki Teshima, Proterial Ferrite Electronics, Ltd.

Shigeyuki Hamayoshi, Proterial, Ltd.

### 3. Invention overview

As the range of applications continues to grow for control circuits that handle large amounts of power, such as power modules that convert and control power with high efficiency and that are used as control components for motors, the insulated substrates used for mounting these components<sup>\*1</sup> are required to not only have insulation properties, but also good thermal conductivity to dissipate heat generated by semiconductors, as well as strength to withstand stress generated from temperature cycling. In recent years, silicon nitride substrates, which provide higher bending strength and fracture toughness, are being increasingly used in place of the commonly used alumina<sup>\*2</sup> and aluminum nitride substrates (Figure 1). The electrification of automobiles in recent years in particular has led to a rapid increase in demand for silicon nitride substrates.

There is a growing need for better productivity to meet this sharp increase in demand for silicon nitride substrates. To address this demand, we needed to increase the amount of silicon nitride substrate that can be sintered simultaneously by layering material sheets and increasing the sizes of substrates in the manufacturing process<sup>\*3</sup>. However, due to the fact that material sheets shrink during sintering, while the boron nitride powder layers for peeling do not (Figure 2), manufacturers have had to deal with problems such as diminished uniformity of physical properties (density and voids [vacancies]) between the center and edge areas of the substrate and a greater tendency of voids which reduce insulation reliability forming during sintering.

To address these problems, this invention focuses on the importance of controlling the thickness of the boron nitride powder layers and eliminating carbon from material sheets. As a result, we have been able to improve the uniformity of physical properties<sup>\*4</sup> and suppress the formation of voids<sup>\*5</sup> in large substrates (120 mm or more per side). With this invention, we are able to realize silicon nitride substrates with high productivity and high insulation reliability.

Through the second half of 2023, Proterial and Proterial Ferrite Electronics plan to invest in increasing the production of silicon nitride substrates that apply this invention and roughly double our production capacity compared to FY 2021 levels<sup>\*6</sup>. We are committed to contributing toward solving our customers' problems by providing highly reliable silicon nitride substrates.

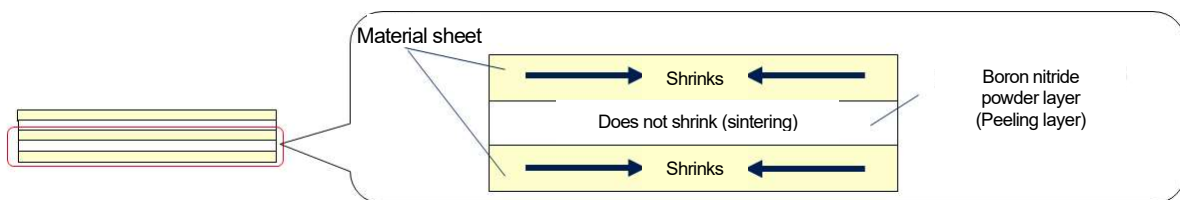
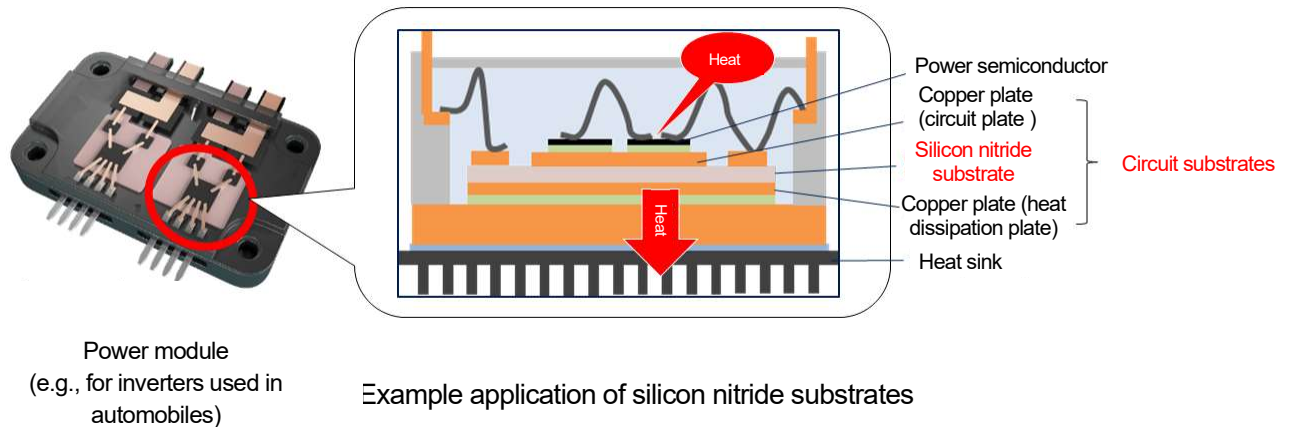


Fig. 2: Behavior of layered raw material sheets and boron nitride powder layers during sintering

End of release

\*1 Mounting: Forming a circuit with conductive material on an insulated substrate and connecting semiconductors or other electronic components to create a device.

\*2 Alumina: Aluminum oxide

\*3 Manufacturing process: Silicon nitride substrates are manufactured by alternately layering raw material formed into sheets with boron nitride powder for peeling before they are sintered. The sintered substrates are peeled off individually and divided into the sizes to be used.

\*4 "dc/de," the ratio of density dc at the center to density de at the edge is 0.98 or greater, and "ve/vc," the ratio of void rate vc at the center to void rate ve at the edge is 0.50 or greater.

\*5 Void rate vc at the center is 1.80% or lower, void rate ve at the edge is 1.00% or lower.

\*6 February 13, 2023 Press Release: "Production of Silicon Nitride Substrates for xEV Power Semiconductors to be Increased"

[Media inquiries] Corporate Communications Dept., Proterial, Ltd.  
e-mail: [hmcc.sa@proterial.com](mailto:hmcc.sa@proterial.com)

[Customer inquiries] <https://www.proterial.com/e/contact/>

## ■ About PROTERIAL

# PROTERIAL

“Proterial” reflects the essence of our corporate philosophy, which consists of three elements: Mission: “Make the best quality available to everyone;” Vision: “Leading sustainability by high performance;” and Values: “Unflinching integrity” and “United by respect.” It combines “pro-” with the word “material.”

“Pro-” represents our “three pros”:

- Professional — work that exceeds expectations
- Progressive — a spirit that keeps challenging
- Proactive — an enterprising attitude

“Material” refers to the high-performance materials that our original technologies produce and underpinned by the three pros. With our focus on solving customer issues and bringing new levels of value, we promise to contribute to the realization of a sustainable society through the products and services that embody our philosophy.

## ■ Proterial, Ltd. — Company Overview

Established: April 1956

Head office: Toyosu Prime Square, 5-6-36 Toyosu, Koto-ku, Tokyo 135-0061, Japan

Capital: 310 million yen (as of March 31, 2023)

Representative: Representative Director, Chairman, President and Chief Executive Officer (CEO)  
Sean M. Stack

Sales revenue: 1,118.9 billion yen (Term ended March 2023)

History: 1910: Founded as Tobata Foundry Co.

1937: Merged with Hitachi, Ltd.

1956: Established separately as Hitachi Metals Industries, Ltd.

2023: Company separated from the Hitachi Group, and renamed from Hitachi Metals, Ltd. to Proterial Ltd.