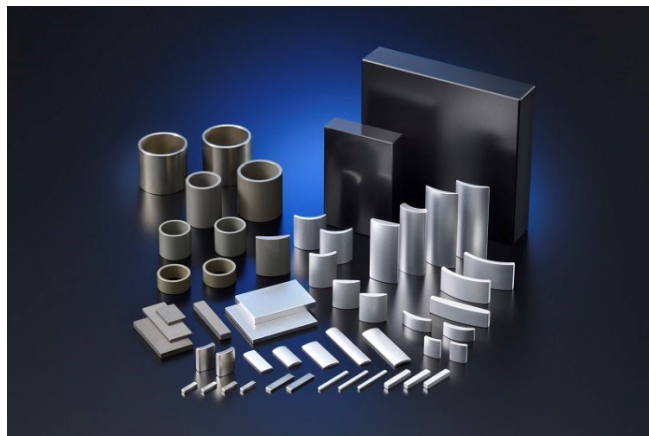


# News Release

July 22, 2025  
Proterial, Ltd.

## Proterial Develops High-Performance Heavy-Rare-Earth-Free Neodymium Sintered Magnet for Electric Vehicle Driving Motors

Proterial, Ltd. (hereinafter, “Proterial”) has developed high-performance heavy-rare-earth-free neodymium sintered magnet with no use of heavy rare earth. It can be used even for electric vehicle (EV) driving motors, satisfying both high residual magnetic flux density ( $B_r$ )\*<sup>1</sup> and high coercive force ( $H_{cJ}$ )\*.<sup>2</sup> Thanks to its high magnetic properties, the product helps avoid the risk of resource depletion for heavy rare earths and contributes to energy saving and CO<sub>2</sub> emission reduction through higher torque, smaller size, and higher efficiency of motors.



Neodymium sintered magnet NEOMAX® (illustrative diagram)

### 1. Background

The electrification of automobiles and aircrafts is moving forward rapidly due to the global trend toward carbon neutrality. Magnets, a component of motors, also need to have high heat resistance since the motors used in these applications are exposed to high temperatures of 100°C or higher. Neodymium sintered magnets are suitable for increasing torque and downsizing motors, given their high magnetic properties. To improve heat resistance, it is necessary to add heavy rare earths.\*<sup>3</sup> However, there are fewer reserves of heavy rare earths than there are of light rare earths, creating the following challenges at a time of rising demand: Volatile prices of heavy rare earths and high resource depletion risk. Accordingly, the need to reduce or avoid the use of heavy rare earths (heavy-rare-earth-free) is increasing with each year.

### 2. Outline

Proterial has been developing and mass producing heavy-rare-earth-free neodymium sintered magnets, which feature increased heat resistance without the use of heavy rare earths. To meet growing needs, Proterial has successfully developed NMX™-F1SH-HF and NMX-G1NH-HF materials. These high-performance, heavy-rare-earth-free neodymium sintered magnets can be used for electric vehicle driving motors, with dramatic gains in residual magnetic flux density ( $B_r$ ) and coercive force ( $H_{cJ}$ ) through its unique textural and compositional control technology.

The NMX-F1SH-HF material has magnetic properties that permit applications for driving motors as well as electric power steering and compressors with  $B_r = 1.40$  T and  $H_{cJ} \geq 1671$  kA/m. Proterial's mass production plant has already started providing pre-production samples.

The NMX-G1NH-HF material is a heavy-rare-earth-free material that can be used even for driving motors

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requiring high torque and heat resistance. Research facilities have achieved magnetic properties that enable use in a hot environment of 100°C or above with  $B_r = 1.42$  T and  $H_{cJ} \geq 1830$  kA/m. Proterial will verify mass production potential. In April 2026, the mass-production plant will be ready to respond to requests for pre-production samples.

### 3. The heavy-rare-earth-saving technology and heavy-rare-earth-free technology of Proterial

As the leader in the neodymium sintered magnet field, Proterial has obtained over 600 patents relating to neodymium sintered magnets around the world and has built a portfolio of more than 200 patents in Japan as a result of long-term research and development, manufacturing and distributing the neodymium sintered magnet NEOMAX®. Particularly determined to bring to the world the most powerful neodymium sintered magnet free from heavy rare earth, Proterial has bolstered its portfolio of patents, concentrating on heavy-rare-earth-free technology development and patent applications while developing heavy-rare-earth-saving technology.

Figure shows a magnetic property map for Proterial's high-performance, heavy-rare-earth-free neodymium sintered magnet. The NMX-F1SH-HF material and the NMX-G1NH-HF material, that is, the new high-performance, heavy-rare-earth-free magnets, have been successfully developed with  $H_{cJ}$  and  $B_r$  dramatically improved from the first-generation NMX-S49F material by controlling impurities and optimizing the composition and process using Proterial's original manufacturing methods.

The NMX-F1SH-HF material has magnetic properties with  $B_r = 1.40$  T and  $H_{cJ} \geq 1671$  kA/m, permitting applications for driving motors as well as electric power steering and compressors. Furthermore, for the NMX-G1NH-HF material, the research facilities achieved magnetic properties with  $B_r = 1.42$  T and  $H_{cJ} \geq 1830$  kA/m to satisfy the strong need for the development of a heavy-rare-earth-free material that can be used for driving motors requiring high torque and heat resistance.

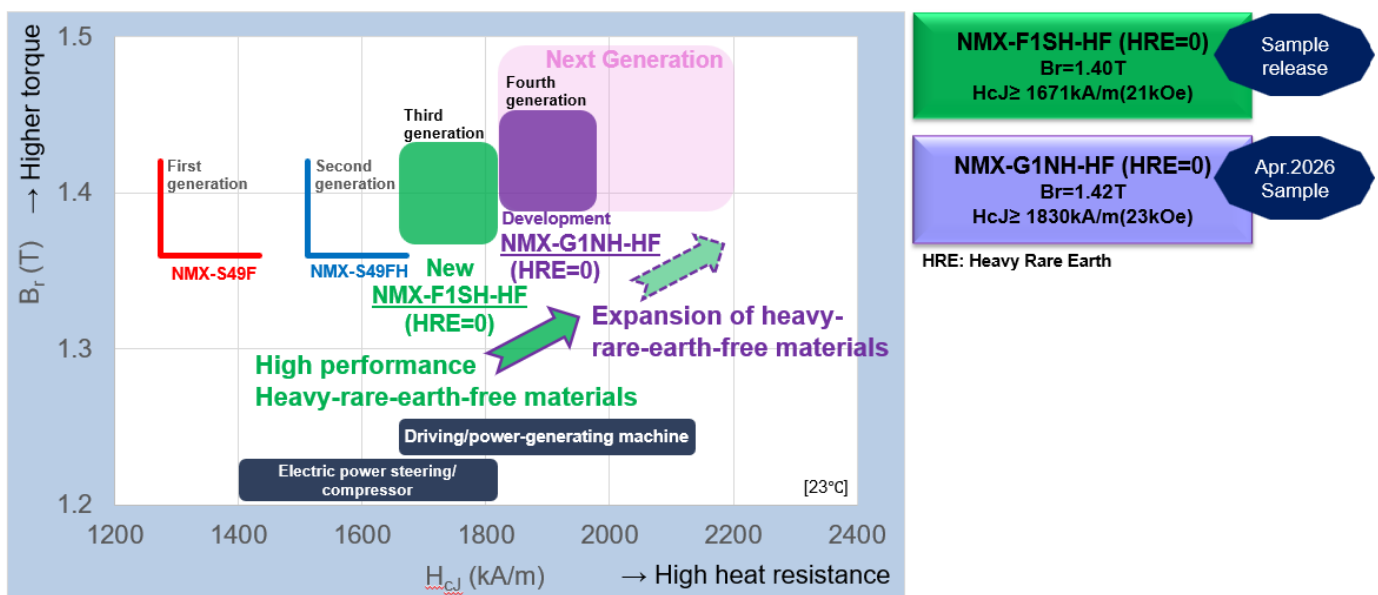


Fig. Magnetic property map for high-performance, heavy-rare-earth-free neodymium sintered magnet

### 4. As a motor material manufacturer

In addition to neodymium magnets, Proterial manufactures and sells Ferrite Magnets NMF™ excelling in cost-effectiveness and having a comparatively small resource risk. Proterial is a comprehensive motor material manufacturer, offering amorphous metal for cores (iron cores), enameled wire, magnetic wedges, and other materials for elevating the performance and efficiency of motors. Proterial will continue to supply varied motor materials to address the motor-related issues of customers.

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Note: The property values given here are representative values and not guaranteed values.

- \*1 Remanence ( $B_r$ ): Index of magnetic force intensity. As it increases, the motor torque can be increased, and motors can be downsized further.
- \*2 Coercivity ( $H_{cJ}$ ): Index of the ability of magnets to withstand demagnetization. As it increases, use is enabled in an environment at higher temperatures.
- \*3 Heavy rare earth: Rare earth elements that contain terbium (Tb) and dysprosium (Dy) and have a high molecular weight.

## (Reference)

Table. The heavy-rare-earth-saving technology and the heavy-rare-earth-free technology of Proterial

Technological system	Applied heavy-rare-earth-saving technology/heavy-rare-earth-free technology	Material code	Simulated amount of heavy rare earth used (Comparison)	Magnetic property Residual magnetic flux density ( $B_r$ ) coercive force ( $H_{cJ}$ )	Remarks
Replacing part of the basic composition of magnet with rare earth	None	NMX-S41EH	10*	$B_r=1.28T$ $H_{cJ}\geq 1989kA/m$	Included as a leading example of the object of comparison with Heavy-rare-earth-saving technology or Heavy-rare-earth-free technology not applied.
Heavy-rare earth-saving technology	Conventional diffusion technology	NMX-U48SH	1	$B_r=1.40T$ $H_{cJ}\geq 1830kA/m$	Included as a representative example with conventional diffusion technology applied.
	M-Diffusion™	NMX-G1NH	Approx. 1/5	$B_r=1.42T$ $H_{cJ}\geq 1830kA/m$	A unique diffusion technology that is more rare-earth-saving than conventional diffusion technology Mass-production ongoing, started in 2019
	Improving M-Diffusion	NMX-H1EH	Approx. 1/5	$B_r=1.45T$ $H_{cJ}\geq 1989kA/m$	Pre-production samples can be provided.
Heavy-rare-earth-free technology	Controlling impurities and optimizing composition and process using unique manufacturing methods	NMX-S49F	0	$B_r=1.39T$ $H_{cJ}\geq 1273kA/m$	First generation
		NMX-S49FH	0	$B_r=1.39T$ $H_{cJ}\geq 1512kA/m$	Second generation
		NMX-F1SH-HF	0	$B_r=1.40T$ $H_{cJ}\geq 1671kA/m$	Third generation Developed and announced this time Pre-production samples can be provided.
		NMX-G1NH-HF	0	$B_r=1.42T$ $H_{cJ}\geq 1830kA/m$	Forth generation Developed and announced this time Achieved by the research facilities. Pre-production samples to be provided from April 2026.

\*Value converted as terbium (Tb)

NEOMAX, NMF, NMX, and M-Diffusion are registered or unregistered trademarks of Proterial, Ltd.

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## ■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, 2025)

Representative : Sean M. Stack

Representative Director, Chairperson, President, & CEO

Sales revenue: 768.6 billion yen (Term ended March 2025)

History: 1910: Founded as Tobata Foundry Co.

1937: Merged with Hitachi, Ltd.

1956: Established separately as Hitachi Metals Industries, Ltd.

2023: Renamed from Hitachi Metals, Ltd. to Proterial, Ltd.

Proterial is a participant of the United Nations Global Compact and adheres to its principles-based approach to responsible business. In January 2025, Proterial received a Silver rating in the EcoVadis Sustainability Assessment.

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