R&D Activities & Achievements

Proterial Group continuously invests in R&D on advanced materials that contributes to sustainable growth and social contribution, particularly in regard to strengthening the creation of new businesses and products that contribute to an environmentally friendly society. At the same time, we are shortening the development period by utilizing digital technologies such as AI and materials informatics.

Research and development expenses (FY2022)

Research and development expenses	12,150 (millions of yen)

Key R&D Themes by Segment (FY2022)

(millions of yen)

Segment Name	Key R&D Themes	Research and development expenses
Specialty Steel Products	Development of materials, manufacturing methods, and related technologies for high-grade specialty steels, various rolling mill rolls, and metal 3D additive manufacturing for the fields of molds and tools, electronic materials, industrial equipment materials, aircraft and energy-related materials, etc.	3,467
Functional Components and Equipment	Development of high-grade ductile iron products, cast-iron products for transportation equipment, heat-resistant cast steel parts for exhaust systems, pipe fittings, valves and other equipment piping components	2,607
Magnetic Materials and Applications / Power Electronics Materials	Development of high-performance magnets, high-frequency parts and materials for information terminals, amorphous metal materials, nanocrystalline soft magnetic materials, various other magnets and ceramic products, and their applied products	1,720
Wires, Cables and Related Products	Development of materials, manufacturing process technology and connection technology related to various electric wires and windings for industrial, vehicle/automotive, equipment, medical, etc., as well as electrical components and hoses for automobiles, industrial rubber, etc.	4,356

R&D Activities & Key Achievements (FY2022)

In fiscal 2022 , our R&D activities produced the key achievements listed below. These achievements are anticipated to contribute to environmental and social issues such as product-weight reduction, fuel efficiency and energy conservation, and decarbonization in industrial infrastructure and electronics-related fields as well as automotive related fields, where the shift to electrification (xEV)*1 is expected to continue.

Segment Name	Key Achievements
Specialty Steel Products	•We have developed and commenced sales high-performance Cast Roll for Cold Rolling (CR2) for use in steel cold rolling.*2 CR2 has high abrasion resistance (roughness retention) and accident resistance*3 required for cold rolling processes, and its introduction into rolling processes will contribute to improved productivity.
Functional Components and Equipment	•We have commercialized valves that use three types of nickel-based alloys as the main body material. ASTM A494 Gr.CW12MW (our trade name MA276, equivalent to Hastelloy C-276), which shows excellent corrosion resistance under both oxidizing and reductive conditions; ASTM A494Gr.CX2MW (our trade name MA22, equivalent to Hastelloy C-22), which has even better corrosion resistance under oxidizing conditions than MA276; and MAT21™, our original alloy with enhanced localized corrosion resistance. These products are used in processes at petrochemical basic product and derivatives plants that handle corrosive fluids in generation processes.
Magnetic Materials and Applications / Power Electronics Materials	•We have developed a new magnetic wedge for motors by developing our proprietary powder metallurgy technology accumulated to date. The high magnetic permeability and reliability of this product will contribute to lower power consumption and CO_2 emissions in society by further realizing low-loss and high-efficiency motors. •Simulations have confirmed that optimizing the design of a motor that applies our high-performance NMF™15 ferrite magnet (hereafter referred to as ferrite magnet motor) achieves the same level of output as xEVs drive motors that use neodymium magnets. Ferrite magnet motors do not use the rare earth materials like neodymium, dysprosium or terbium, which are particularly limited in quantity, and are therefore expected to reduce resource risks and costs in response to the growing demand for xEVs.
Electric-wire Materials	•To decarbonize electric wires and cables, we have developed cabtire cables that can reduce CO_2 emissions by around 25% compared to conventional cables. The application of silane cross-linking technology has enabled lower CO_2*4 emissions in manufacturing processes (raw material purchases, product manufacturing). •We have developed silicone cables with new UV-C sterilization treatment resistance and is an addition to our medical-use silicone cable brand SilMED, which combines high slipperiness and chemical resistance. This coating technology is expected to be applied not only to medical wire cables but also to various types of sterilizable medical equipment.

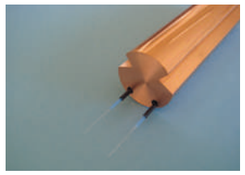
*1 General term for electric vehicles (EV), hybrid electric vehicles (HEV), plugin hybrid electric vehicles (PHEV)
*2 A rolling process that is basically performed at normal or room temperature. The temperature of the material rises due to the heat generated when the material is deformed by rolling.
*3 Rolling accidents are defined as cracking or burning on the surface of rolls during rolling due to sudden thermal load, etc. The resistance to these rolling accidents is comprehensively evaluated based on the degree of cracking or burning and the numerical value of fracture toughness.
*4 CO_2 emissions are calculated using the CFP (Carbon Footprint) calculation method.
*Hastelloy and C-22 are registered trademarks of Haynes International, Inc.

Topic 1

Wins Masuda Award of Grand Prize at the 65th of the Best 10 New Products organized by Nikkan Kogyo Shimbun

Fiber-optic warning system for contact wire

Shinkansen bullet trains and other rolling stock run by receiving power from contact wires above the track through pantograph units fitted to their rooftops. Due to the structure where pantographs and contact wire are in contact, in the worst cases the contact wires break due to the effects of friction, preventing trains from running. To prevent this, conventional warning systems place a metal detection line inside the contact wire and monitor friction based on the presence or absence of a flowing current. However, this approach means that detection can only be performed at night when no noise is produced by running trains.
The fiber-optic warning system for contact wire that JR Central and Proterial jointly succeeded in commercializing uses fiber-optics for the detection line, making it possible to constantly monitor the state of contact wires and ascertain the progression of friction in real-time. This makes it possible to prevent contact wire breakage incidents before they occur.
Proterial will continue to respond to increasingly diverse needs as it strives to develop the high-performance materials that support social infrastructure.



Fiber-optic warning system for contact wire

Topic 2

Awarded the 2023 Asahi Prize National Commendation for Invention

Invents steel annealing method that does not use heating furnaces

Depending on the temperature at which the steel is heated and the speed at which it is cooled, the microstructure of the steel changes (transforms) mainly to austenite, pearlite, martensite. Heat treatment is the process of intentionally transforming steel by utilizing these characteristics to obtain the appropriate properties for an intended purpose.
This invention is related to annealing methods for transforming to a pearlitic structure without using a heating furnace in semi-finished steel products such as hot mold steel after hot working. The heat generated during the transformation from austenite to pearlite (latent heat of transformation) is utilized by placing the material in an incubator, and the material is successfully converted to pearlite. No heating furnace, fuel or electricity is required, making it possible to reduce CO_2 emissions from these sources. It is also possible to move steel while keeping it warm, enabling efficient production that takes into consideration the next process.

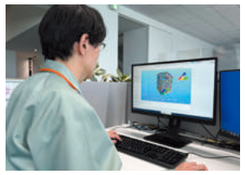
Annealing work using an incubator

Topic 3

Multiscale Integrated Simulator for Metal Additive Manufacturing

Develops AM-DT

Proterial, in collaboration with the Institute of High Performance Computing at Singapore's A*STAR (Agency for Science, Technology and Research), has developed a multi-scale integrated simulator for metal additive manufacturing.
Metal additive manufactured products are made in a one-part, one-sheet manufacturing process, so there has been limited means to evaluate the functionality of the products. This has prevented the expansion of applications because information necessary for design cannot be obtained. The Additive Manufacturing Digital Twin (AM-DT), an integrated simulator developed by Proterial, enables computer simulation of physical phenomena in metal additive manufacturing—including metal powder feeding, local melting mainly by lasers, rapid solidification, and product cooling—at different scales to suit each process. This makes it possible to reproduce metal additive manufacturing in a virtual space (realize digital twin*) and one-stop operation from product design, manufacturing plan development, quality design to evaluation in a virtual space. This will help expand and popularize of metal additive manufacturing applications.



* Digital twin: Reproduces real space information in digital space.