Technology and R&D

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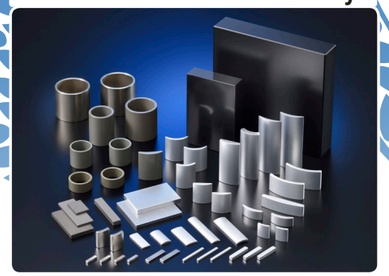
Examples of Products That Help Realize a Sustainable Society

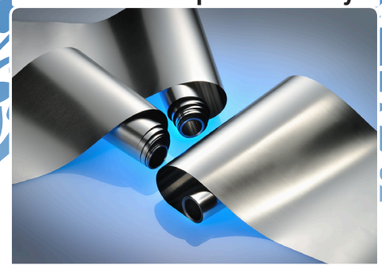
The growing effects of climate change, reflected in rising sea levels and increasing storm and flood damage due to abnormal weather events, are prompting people around the world to take action to reduce environmental impacts. The Hitachi Metals Group focuses on developing key environmentally conscious products and providing them to customers in wide-ranging fields, such as automobiles and electric power. In these ways, we contribute to the realization of a low-carbon society.

For the automobile industry



NEOMAX® neodymium magnets

For the electric power industry



Metglas® amorphous alloy ribbon

SUSTAINABLE DEVELOPMENT GOALS

17 GOALS TO TRANSFORM OUR WORLD

In 2015, the United Nations adopted a set of 17 Sustainable Development Goals (SDGs) as part of a universal action plan aimed at ending poverty, protecting the planet, and ensuring peace and prosperity for all people by 2030.

Neodymium magnets: Contributing to popularization of xEVs

In 1982, our company (then called Sumitomo Special Metals) invented a neodymium magnet with a much stronger magnetic force than ordinary ferrite magnets. In general, a stronger magnetic force of the magnet means higher performance of the motor, which contributes to miniaturization and weight reduction. In light of technological advances in xEVs*, neodymium magnets play a significant role, which are indispensable for making motors smaller and lighter, thus increasing efficiency and saving energy. The Hitachi Metals Group was the first in the world to develop and mass-produce neodymium magnets, sold under the NEOMAX® brand. Boasting the world's strongest magnetic force among permanent magnets, NEOMAX® magnets are used in various fields, including automobiles, IT, home appliances, industry, medical devices, and environment and energy. Currently, we are focusing on increasing our presence in the automotive market, which is undergoing transformation due to advances in connectivity, automated driving, and electrification. Supplying high-performance neodymium magnets for around 1.18 million vehicles annually, we contribute to higher efficiency and downsizing of xEV drive motors and generators.

* xEV: A generic term for electric vehicles (EVs), hybrid electric vehicles (HEVs), and plug-in hybrid electric vehicles (PHEVs).

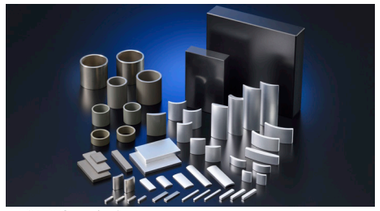
High-performance neodymium magnets supplied by the Group annually

Approx. 1.18 million vehicles

sustainable use of rare earth materials

Neodymium magnets are expected to find more widespread use as companies work to realize an energy-efficient society. These magnets consist mainly of neodymium, iron, and boron, a composition that is vulnerable to heat and whose magnetic properties deteriorate when the temperature exceeds around 80°C. Therefore, it is necessary to add dysprosium (Dy) and terbium (Tb), which are heavy rare earth elements.

Neodymium and heavy rare earth elements are indispensable materials for the evolution of magnets, but since they are derived from natural resources, there are risks in terms of procurement stability and costs. Because it is difficult to reduce the amount of neodymium, which is the basic composition of the magnets, the Group has been developing the NEOMAX®F Series since 2014, reducing the amount of heavy rare earth elements while maintaining heat resistance. By limiting the use of rare earth elements, we contribute to their sustainability.



NEOMAX® neodymium magnets

Rare earth magnet business

We produce neodymium rare earth magnets (neodymium magnets), which are indispensable for advances in miniaturization, weight reduction, and operational and energy efficiency. They are used in motors in such fields as automobiles, IT, home appliances, industry, medical devices, and environment and energy. In the automotive field, they are used in xEV drive motors and generators.

	Contribution to SDGs	Value created
Environmental value	7.3 / 11.6 / 13.1	We provide high-performance rare earth magnets for xEV applications in order to improve fuel efficiency, reduce vehicle exhaust emissions, and enhance operational efficiency and miniaturization of xEV drive motors and generators, stemming from replacement of internal combustion engines with xEV motors. (Approximately 1.18 million vehicles/year equivalent) [Customer value created] *Based on the amount used and shipment volume for xEV applications Developing magnets that require less heavy rare earth resources (less heavy rare earth magnets) will reduce the use of such resources. [In-house value created]

Potential risk of business on society/environment	Response
Environmental destruction due to rare earth mining; poor working conditions	Procure from companies that care for the environment and working conditions

Amorphous alloys: Contributing to energy efficiency of power transformers

Transmission energy gets lost as electricity travels from the power plant to factories and homes. High-voltage electricity sent from the power plant is converted to low-voltage electricity by transformers for safety reasons. However, transformers not only consume power during the conversion, but also when in standby mode.

To solve this problem, the Hitachi Metals Group developed an amorphous alloy called Metglas®. Transformers using Metglas® as the core material consume around one-third of the power of those using conventional materials, such as magnetic steel sheets. We have been supplying this alloy since 2003. Unlike ordinary metals and alloys, amorphous alloys have excellent soft magnetic properties due to their lack of crystal structure, which makes it possible to suppress power loss in standby mode. To date, the Group has provided Metglas® as the core material for around 480,000 amorphous transformers. Compared with magnetic steel sheet transformers, this translates to a reduction in CO_2 emissions* of approximately 50,000 tons per year.

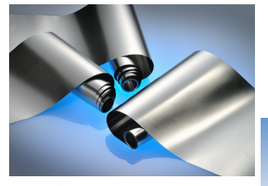
* Based on shipment volume and difference in transformer energy loss, according to Indian standards
For the CO_2 emission coefficient, we use IEA CO_2 emissions from fuel combustion (2017 world).

CO_2 emissions compared with conventional transformers

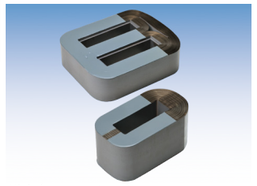
Approx. 50 thousand-ton reduction

Pursuing new possibilities for materials and developing products that help reduce environmental impact

Because amorphous alloys can contribute to energy savings in various products, we anticipate their deployment in many areas other than transformers. Unlike general metals, amorphous alloys are hard yet flexible, meaning they are difficult to deform or cut. However, there are still many unknown points about this principle. Hitachi Metals participates in the Next Generation TATARA project, a joint initiative by regional universities and industry promoted by Shimane University. Under the project, we engage in research aimed at further clarifying the properties of amorphous alloys. By deepening our understanding of these materials and establishing solid theories, we believe we can create new production methods and processes and develop eco-friendly products that help reduce environmental impacts.



Metglas® amorphous alloy ribbon



High-frequency transformer core

Soft magnetic materials business

We produce soft magnetic materials used in energy-saving transformers and noise suppression components in industrial and electronic equipment.

	Contribution to SDGs	Value created
Environmental value	7.3 / 13.1	Compared with transformers using conventional soft magnetic materials, such as grain-oriented magnetic steel sheets, the no-load loss (standby power) of those using amorphous alloys is low, at around one-third. We provide high-efficiency amorphous transformer materials that can significantly reduce power conversion loss (used in around 480,000 transformers). This translates to an annual CO_2 emission reduction of around 50,000 tons compared with transformers using grain-oriented magnetic steel sheets. [Customer value created]

Potential risk of business on society/environment	Response
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Aiming to Be a "Genuinely Development-Driven Company"

In April 2017, the Hitachi Metals Group opened the Global Research & Innovative Technology center (GRIT), reflecting its principle to "promote research, development, and innovation for the future, to become a genuinely development-driven company." In April 2018, we opened a new facility within GRIT consisting of a research building and an experimental building. Through collaboration between GRIT and the research facilities of our business divisions, we promote cross-departmental projects and open innovation in our quest to create new levels of value.

Main R&D achievements in fiscal 2018

In fiscal 2018, the Group made investments in R&D totaling ¥18.6 billion and achieved the following results.

Specialty Steel Products — Contributing to xEV popularization with motor components and lithium-ion battery components and materials

To improve the efficiency of motors, we have developed a motor core consisting of amorphous metals. We will forge ahead with R&D aimed at applying this technology to xEV drive motors (see page on right for details).

In addition, we developed a lithium-ion battery clad terminal, processed from aluminum and copper clad materials*1, with the aim of improving the connection reliability of automotive lithium-ion batteries used in harsh conditions, such as high- and low-temperature environments. We expect this to help reduce battery weight and assembly time.

In addition, we started mass production of soft ferrite core materials with excellent high-frequency characteristics, to foster advances in miniaturization and energy efficiency of network devices, automobiles, and smartphone components.

Magnetic Materials and Applications — Contributing to downsizing and cost reduction of power module cooling mechanisms

Power modules are used in such fields as industrial equipment, automobiles, rolling stock, and new energy. To reduce the size and cost of power module cooling mechanisms, we developed a silicon nitride substrate with high thermal conductivity (130W/m-K) and mechanical properties. It can also handle high-temperature environments, in which silicon carbide (SiC) semiconductors are generally used.

Functional Components and Equipment — Contributing to reductions in seawater desalination costs

We have developed a ceramic adsorption filter that minimizes fouling of RO*2 membranes used in seawater desalination. This is expected to reduce the cost of producing freshwater. Going forward, we will accelerate efforts toward commercialization and expand the business in Singapore, a major center of the water treatment industry.

Wires, Cables, and Related Products — Addressing need for higher-performance rolling stock

Utilizing our unique fire safety design technology for rolling stock wires and cables, we developed a LAN cable for rolling stock that complies with the European railway fire safety standard. By adding this product to our lineup, we will meet demand for high-performance rolling stock in Europe and Asia.

*1 Clad material: A material in which two or more different metals are bonded together, giving it composite properties that cannot be obtained with a single material.
*2 RO: An abbreviation for Reverse Osmosis. Two bodies of water of different salinity are placed adjacent to each other via a membrane that allows only water molecules to permeate; if the high salinity side is pressurized, the water molecules move to the low salinity side.

Groupwide technological development to enhance motor efficiency

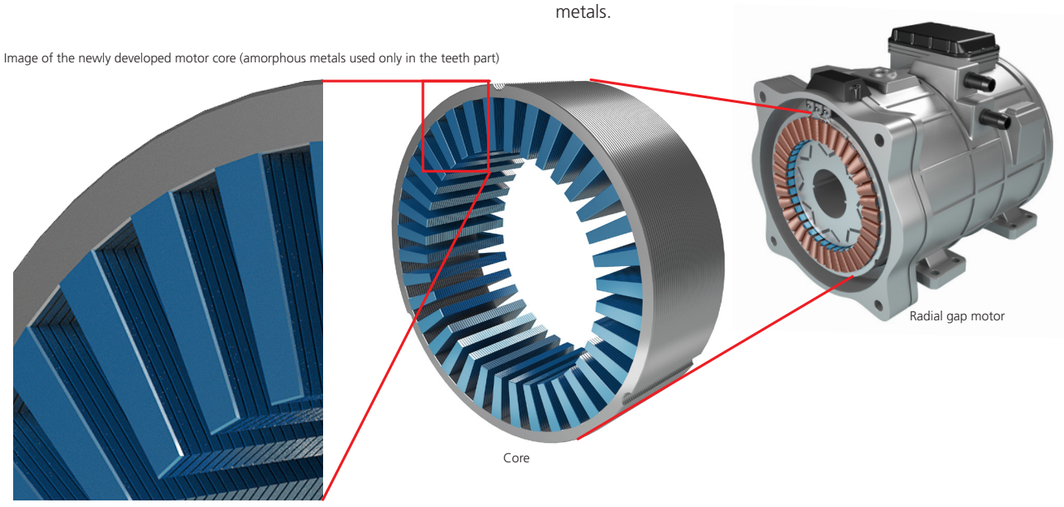
By establishing GRIT, we have put in place a system for pursuing medium- and long-term research themes across the Group. Our aim is to create new businesses and products by organically combining technologies and information to drive innovation. Here, we introduce our development of a motor core structure using amorphous metals.

Developers gather at GRIT to create a new structure

Using our Metglas® amorphous metals, we have developed technology to improve the efficiency of motors. This is in response to calls from various sectors—including those related to automobiles, industrial infrastructure, and electronics—for motors that are smaller, lighter, and more efficient. It is the result of R&D on using amorphous metals for motor cores, because core loss from amorphous metal cores is 10% or less than for cores using magnetic steel sheets.

Due to the thinness of amorphous metal, a higher number of sheets to be processed is required. Moreover, the post-pressing assembly process is difficult and reduces the life of the press mold. Therefore, amorphous metals are more difficult than magnetic steel sheets to process, and transforming it into complex shapes comes with many challenges. Through open innovation by internal and external development teams centered on GRIT, we solved the problem by creating a structure in which amorphous metals are used only for the teeth part, rather than making the entire core from amorphous metals.

Image of the newly developed motor core (amorphous metals used only in the teeth part)



Teeth part
Core
Radial gap motor

Prototype motor combining multiple Group technologies

We have made a prototype motor that incorporates multiple materials possessed by the Hitachi Metals Group. These include Metglas® amorphous metals (used in the motor core), HIDENSE™ ultrahigh-density bonded magnets, and enamel wires. Reflecting its high energy efficiency, this prototype motor achieved an IE5*3 rating, the highest in the world for motor energy efficiency.

The aim of making the prototype was to demonstrate the superiority of amorphous metal as a motor material. Looking ahead, we will proceed with R&D to find applications in xEV drive motors and the like, while proposing new application methods for motor materials backed by demonstration data.

*3 The highest level in the guideline for motor energy efficiency under IEC60034-30-2, currently being discussed and formulated by the International Electrotechnical Commission (IEC).

Prototype motor