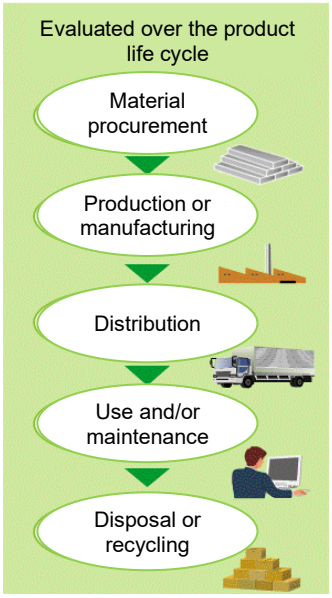
2. Environmental Consideration in Products

The Hitachi Metals Group considers “Thinking about the next generation—An environment-friendly solution” an important managerial issue. We contribute to the realization of a sustainable society through the creation of new products and new technologies that meet such needs, as well as through the provision of advanced environmentally conscious products.

(1) Environmental Consideration (Life Cycle Assessment [LCA]) in Products and Services



For the purpose of contributing to the realization of a sustainable society, the Hitachi Metals Group is focusing attention on the environmental and energy sectors when promoting the development of new products. Moreover, for the development and design of such new products, we promote environmentally friendly product development based on the “Hitachi Group Eco-Design Management Guidelines” (revised version), which takes product life cycles into account.

Eco-design that takes product life cycles into account has begun to be required by various international initiatives, including the revision of ISO 14001:2015 and the establishment of IEC 62430[*1] as well as national regulations for energy-saving products. In order for evaluations to be made from the viewpoint of life cycles based on IEC 62430, the Hitachi Metals Group revised its environmentally conscious design assessment and LCA systems in fiscal 2016. Using these assessment tools, we promote product development and design in consideration of environmental impacts the product will have on the environment throughout its entire life cycle that ranges from procurement and manufacturing to use and disposal by the customer.

The table below shows examples of the Hitachi Metals Group’s environmentally friendly products and technologies that are applied to the environment and energy-related fields.

*1. IEC 62430: The standards set by the International Electrotechnical Commission (IEC) for “Environmentally conscious design for electrical and electronic products”

Examples of the Hitachi Group’s environmentally friendly products and technologies applied to the environment and energy-related fields

Field of application			Products and development technologies
Energy	Renewable energy	Solar cells	Amorphous cut core, dust choke coil, target materials
		Wind-power generation	Rare earth magnets, amorphous metal materials, fine met core, magnet wires
	Energy saving and high efficiency	Power generation facilities	Super-heat-resistant metal materials, precision cast blades for turbine wheels
		Home appliances	Magnets for air conditioners and refrigerator compressors, high-efficiency amorphous motor components
	Electricity storage/transformation	Transformers	Amorphous metal materials for low-loss transformers
		Batteries	SOFC[*2] fuel cell parts (interconnector materials, heat-resistant parts), electrode members for secondary batteries, clad metals, xEV battery cases
Mobility	Automobiles	Emissions control	Components that help clean exhaust gas
		Light weight	Lightweight undercarriage, magnets for EPS[*3], various sensors

		High efficiency	Heat-resistant cast steel materials, CVT*4 belt materials
	Hybrid/EVs	Motors	Rare earth magnets, amorphous metal materials, amorphous motors, fine met core, clad metals for secondary battery electrodes, highly efficient magnet wires
		Inverters and other devices	Members for fast charging, aluminum cast inverter cases, silicon nitride substrates, power harnesses
	Railway	More efficient, compact, lighter weight	Cables for rolling stock
	Aviation	Longer life and higher efficiency	Ni-based alloy large forged parts for aircraft engines, high-heat-resistance/high-corrosion-resistance alloys
All industries/ Infrastructure	Industrial equipment, etc.	Aircraft components	Long-life die steel, carbide rolls, corrosion/heat-resistant fittings, Eco-Green cables, additive manufacturing technology
	Water treatment	Seawater desalination	Ceramics adsorption filters for pretreatment of seawater desalination
	Electronics	More efficient, compact, lighter weight	Communication modules, multilayer ceramics components, silicon nitride substrates

*2. Solid Oxide Fuel Cell; *3. Electronic Power Steering
*4. Continuously Variable Transmission

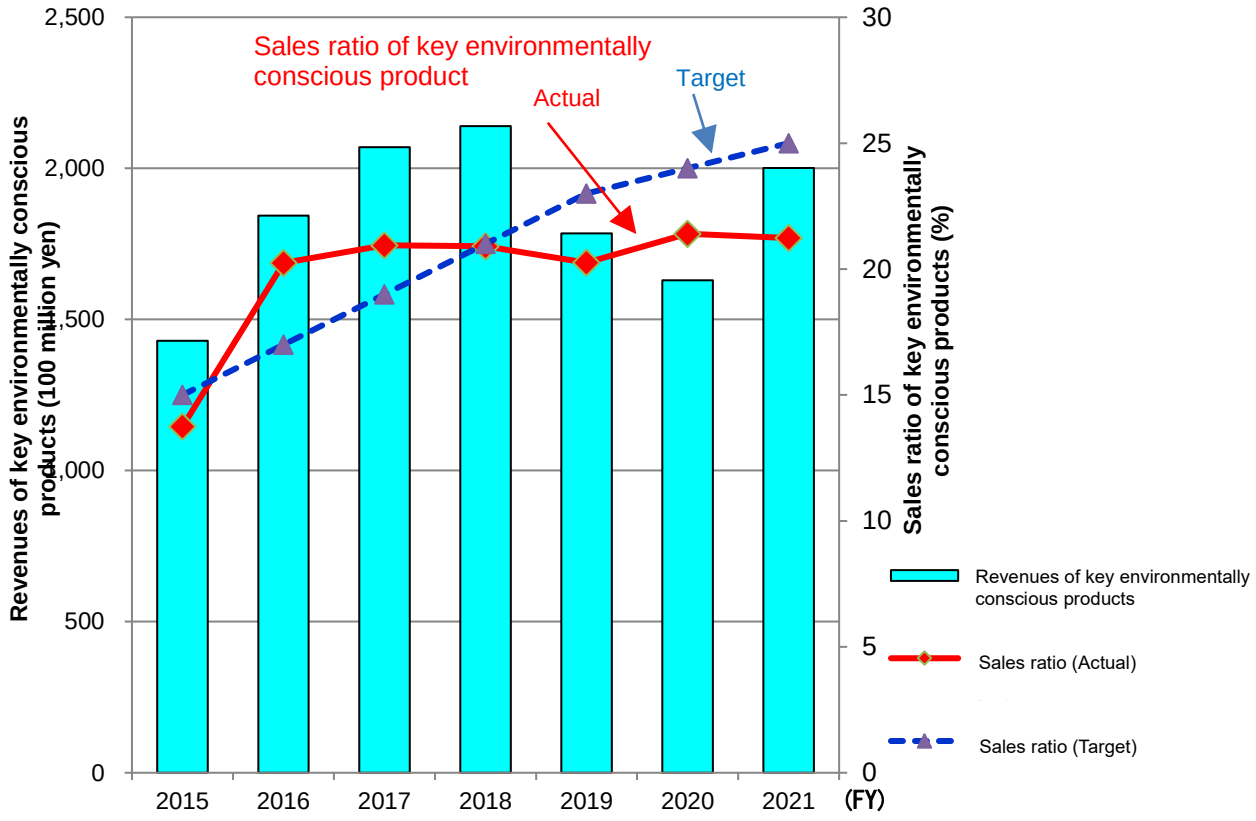
(2) Expansion of Key Environmentally Conscious Products

The Hitachi Metals Group defines environmentally conscious products as those targeted for growth based on a management strategy and that make a significant contribution to resolving environmental issues such as climate change and resource recycling. The Group is promoting the increase of revenue from environmentally conscious products.

In fiscal 2021, revenues from sales of key environmentally conscious products increased to 200.1 billion yen, reflecting an improvement of 37.1 billion yen from the previous year, when sales declined chiefly due to production being reduced globally as a result of the spread of COVID-19. However, the revenue ratio on a consolidated basis remained unchanged from the level of the previous year at 21.2%, falling short of the target (24%).

Going forward, we will expand the lineup of target products and promote sales, aiming to contribute to tackling environmental issues facing our society (climate change, resource recycling, etc.).

Revenues and Sales Ratio of Key Environmentally Conscious Products

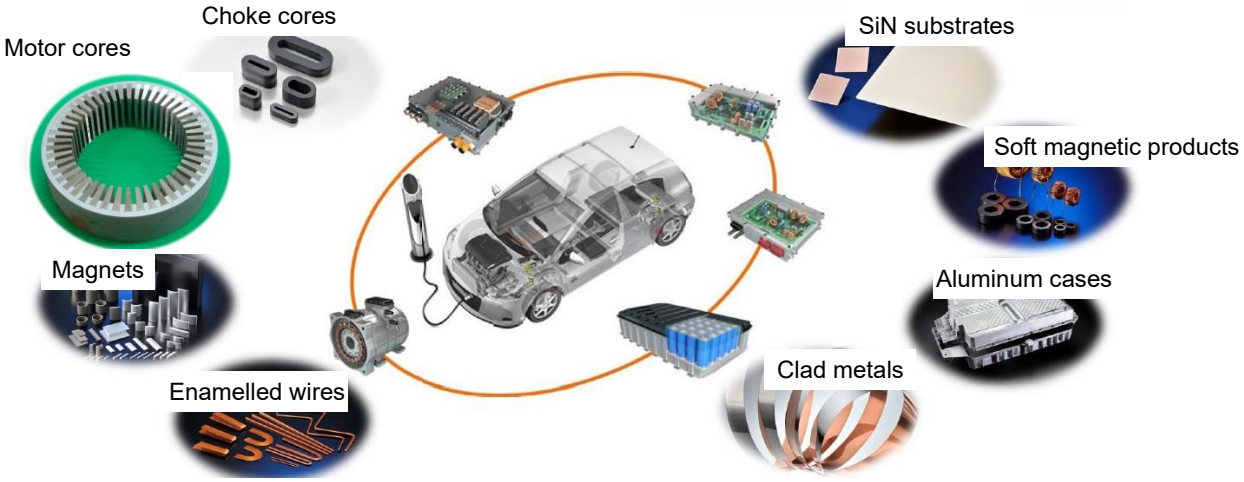


(3) The Hitachi Metals Group's Environment- and Energy-related Products

The Hitachi Metals Group develops and delivers materials and products in fields ranging from generators and transformers through to factories, plants, offices, homes, and vehicles, contributing to the environment and energy across wide-ranging areas of society.

Introducing Environment- and Energy-related Products

■List of our xEV*1-related products



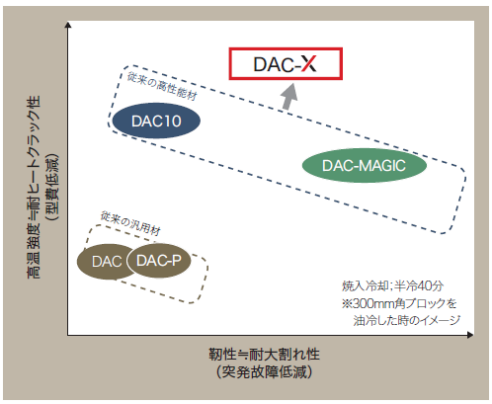
*1. xEV: A generic term for electric vehicles (EVs), hybrid electric vehicles (HEVs), and plug-in hybrid electric vehicles (PHEVs)

■Die steel for die-casting DAC-X® with outstanding strength at elevated temperatures

Tool Steel Department, Specialty Steel Business Unit, Advanced Metals Division

Recently, as the application of diecast parts for xEVs has been expanding, die-casting molds have been required to withstand severer usage conditions, including for use of high-melting point aluminum alloy and higher-cycle casting of products. Particularly, for molds to be applied to produce gate-related parts and small and medium-size nested structures, high strength at elevated temperatures is required to endure softening temperature conditions. In response to this requirement, we have developed DAC-X®, steel for die-casting with outstanding strength at elevated temperatures. DAC-X® represents a new high-performance die-casting steel with strength at elevated temperatures and toughness achieved at higher levels than previous products, which has been made possible through ingredient improvement and process innovation.

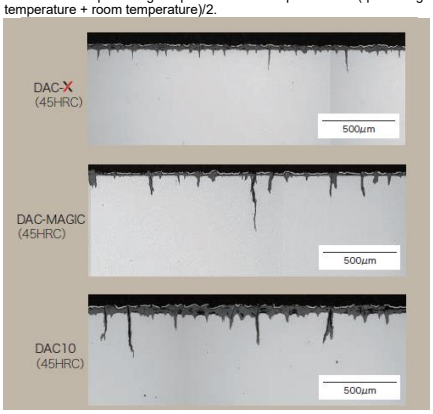
The new product can improve the heat crack resistance, effecting longer mold life, which will contribute to effective use of resources and decarbonization.



Hitachi Metal's die-casing steel lineup

DAC, DAC-X, and DAC-MAGIC are registered trademarks of Hitachi Metals, Ltd.

Quenching temperature: 1,030°C; quench cooling: half temperature time (40 min.)
Half temperature time: time (minutes) required for the material to cool down from the quenching temperature to that equivalent to: (quenching temperature + room temperature)/2.

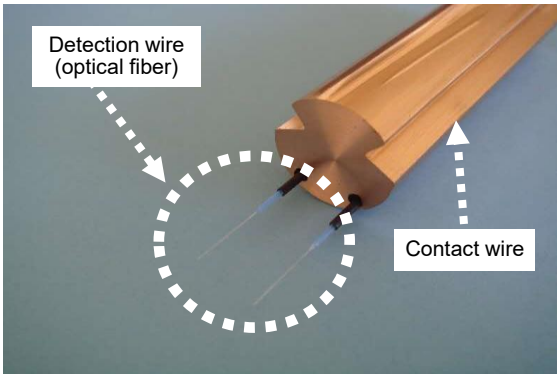


Microscopic cross-section view of the material subject to 3,000 heating (650°C) and quenching cycles

■ Fiber-optic contact wires

Casting & Wiring Department, Electric Wire & Cable Business Unit, Advanced Components and Materials Division

In the electric railway system, including for Shinkansen lines, the train vehicle receives electric current fed from the overhead line (contact wires) through the pantograph mounted on the roof while on the track. The contact wire is in direct contact with the pantograph. Due to this structure, the contact wire is inevitably susceptible to abrasion wear, which may cause broken wires resulting in a stoppage of train service in the worst-case scenario. As a measure to solve this problem, a contact wire wear detection system was developed. The previous model was equipped with metallic wires built in to monitor abrasion wear by sensing the current flow, and this configuration limited the detection functionality to non-service nighttime hours when it was not disturbed by noise from the running train. To address this issue, Hitachi Metals launched a joint project with Central Japan Railway Company (JR Central) to develop a new model adopting optical fibers for the detection wire. This was designed to enable around-the-clock real-time monitoring of the wear status of contact wires. The new fiber-optic contact wire wear detection system was successfully commercialized in 2021. In addition, this system has enabled the centralized monitoring of the wear status from the Shinkansen General Control Center, as opposed to the previous system requiring on-site checks, resulting in a significant decrease in maintenance work hours.



Fiber-optic contact wires

Shinkansen General Control Center

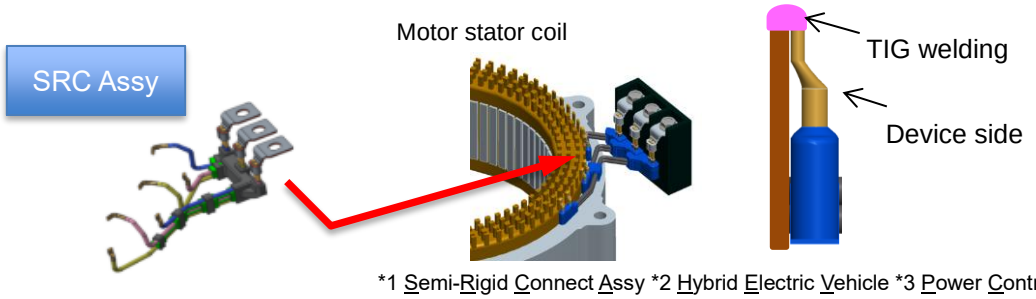
■ High-accuracy and high-configurability xEV motor wiring components (SRC Assy*1)

Automotive Components Business Unit, Advanced Components and Materials Division

Aiming for carbon neutrality, national and regional governments as well as auto manufacturers around the world are announcing various plans and targets, represented by the commitment made by Europe, the US, and Japan individually to ensuring that all new vehicles sold in and after 2035 will be electric.

In this situation, the HEV*2 market is expanding currently in response to transition demand, and targeting this market, we are increasing the supply and marketing of xEV wiring harnesses and SRC assy, which went into mass production in 2019. The SRC assy supplies electric power from the motor or generator to the PCU*3, a critical function for the vehicle to serve its essential purpose of “running.” This product is designed to be connected by welding to the customer’s device containing the stator coil, which requires a high level of wiring configurability and high dimensional accuracy to lay out six wires so that the device can perform effectively. In order to address this challenge, we discussed plans from the development stage

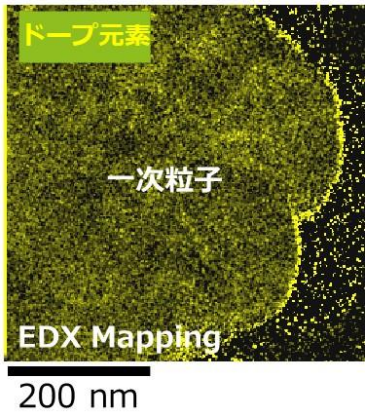
to satisfy the customer's requirements and worked on the plans by trial and error. Furthermore, we developed a full automatic mass-production line for high-accuracy products. The line was expanded to increase output at the China base. Going forward, we plan to expand the development of these products, as part of our efforts to increase contribution to carbon neutrality. For this purpose, we will promote development and marketing activities to cater to customer needs in a fine-tuned manner.



*1 Semi-Rigid Connect Assy *2 Hybrid Electric Vehicle *3 Power Control Unit

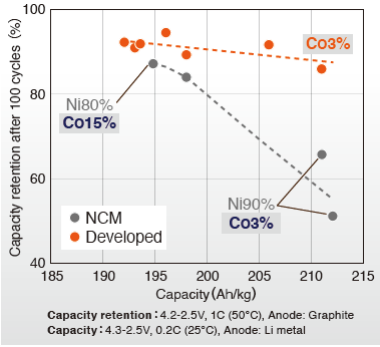
■ High-capacity nickel-based cathode materials for lithium-ion batteries (development technology)

Global Research & Innovative Technology Center



Lithium-ion batteries (LIBs) are used in a wide range of fields, from mobile devices to hybrid and electric vehicles, and demand for LIBs is expected to grow rapidly, especially for use in electric vehicles (EVs). In order to facilitate the popularization of EVs, it is necessary to improve the total and per-charge mileage. One key solution to this issue can be provided by cathode materials that achieve LIBs with high capacity and long life at the same time. Generally, the cathode of automotive LIBs is fabricated with three-element layered materials.

One method for expanding the capacity of this type of cathode is to raise the content of nickel, the base metal, to increase the lithium-ion insertion/de-insertion capacity. The problem of this method, however, is that higher content of nickel lowers the material's endurance to charge/discharge cycle, resulting in shorter battery life.



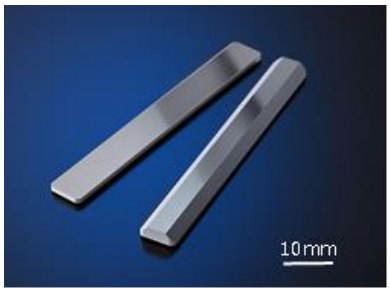
To address this problem, we have developed a micro-structure control technique to suppress degradation of the crystal structure of the cathode subject to the charge/discharge cycle. This technique can prevent a shorter battery life while the nickel content is raised from the conventional 80% to 90% in order to increase the capacity. At the same time, this process has allowed for a reduction in the content of cobalt (by 80% against our comparable products), an essential component of the cathode material especially for the purpose of stabilizing the crystal structure. Given that cobalt is a scarce resource and generates a significantly larger amount of greenhouse gases (GHGs) than the other base components,

reducing the cobalt content constitutes a substantial contribution to reduced GHG emissions from the manufacturing of cathode materials and LIBs.

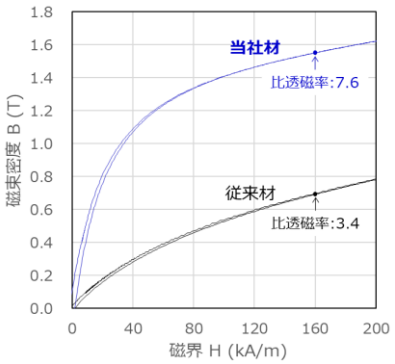
■Magnetic materials for motors 楔 (development technology)

Global Research & Innovative Technology Center
Power Electronics Materials Business Unit, Advanced Components & Materials Division

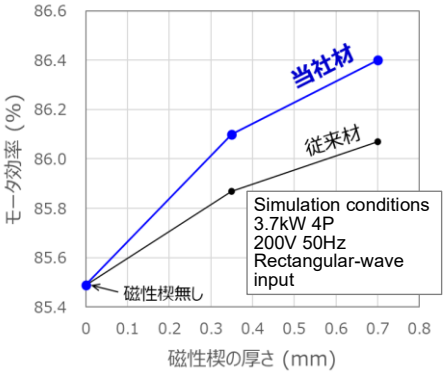
It is said that motors consume nearly 50% of the global supply of electric power, and as such, improving the efficiency of this mechanism is one of the most overriding issues of energy-conserving and CO_2 emissions reducing technologies. Against this background, we have developed new high-performance magnetic slot wedges. This represents the technology that is often used to increase motor efficiency, specifically by improving the magnetic flux distribution within the motor. With previous products, however, the improvement effect was limited due to the inadequate density of magnetic particles and magnetic permeability. In comparison, our recent development technology, an application of our proprietary powder metallurgy technique, provides a higher density of magnetic particles, and achieves permeability that is about double the level of the previous products. A computer simulation suggests that use of the new high-permeability magnetic slot wedges is expected to increase the motor efficiency by about 0.9% compared to no technology of this kind being used and about 0.3% compared to use of previous products. We plan to mass-produce this magnetic slot wedge technology, looking to contribute to a low-carbon society.



Magnetic slot wedges
(external view)



Comparison of magnetic properties



Comparison of motor efficiency

3. Environmental Consideration in Manufacturing

This is a graphical representation of the balance of materials in manufacturing processes at the Hitachi Metals Group for fiscal 2021.

The Hitachi Metals Group is promoting the reduction of the environmental burden in two directions: reducing the volume of input through the efficient use of resources and energy, and reducing the volume of output by controlling atmospheric releases and wastewater discharges, reducing and recycling waste, and so on.