Aiming to Be a “Genuinely Development-Driven Company”

In April 2017, the Hitachi Metals Group opened the Global Research & Innovative Technology center (GRIT), a reflection of 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. We will continue to invest in R&D on advanced materials that foster sustainable growth and contribute to society. At the same time, we will deploy AI, materials informatics, and other digital technologies to shorten product development periods.

Main R&D achievements in fiscal 2019

In fiscal 2019, the Group made investments in R&D totaling ¥15.9 billion and achieved the following results. We will contribute to advances in weight reduction and fuel and energy efficiency of products in fields related to industrial infrastructure, electronics, and automobiles, where electrification (xEV)*1 is making progress.

Specialty Steel Products

- The Group developed MVF-5X, a new Mo alloy with high corrosion resistance and the high adhesion properties needed for high-performance thin-film devices and the low stress and flex resistance needed for flexible substrates. This product is expected to be used as a foundation film for ensuring the adhesion of functional thin films and as a cap film to protect surfaces.
- The Group developed SLD®-f, a prehardened die steel*2 with a 60 HRC-level hardness (versatile hardness of cold press dies) to which the cutting process can be directly applied when dies are produced. This product has the characteristics needed for die steel and is expected to open up new possibilities in the production of dies.
- The Group developed Tribec®SC, a physical vapor deposition (PVD) coating with improved erosion resistance and corrosion resistance using thick-film coating and blocking layers. The application of Tribec®SC to die casting and injection molding dies can be expected to increase the useful lives of dies.

Functional Components and Equipment

- The Group developed electrically operated segment ball valves with a variable opening/closing speed function that enables high-speed openings and closings. By combining the torque characteristics of these valves with those of electric motors inside actuators, users can set a minimum time of one second or a maximum time of 16 seconds for openings or closings.

Magnetic Materials and Applications

- The Group developed MaDC-A™, a magnetic domain control Fe-base amorphous alloy that can contribute to size and weight reduction and higher efficiency of distribution transformers. This product features approximately 25% less core loss than the Group’s conventional products and is expected to reduce environmental impacts.
- The Group developed the MaDC-F™ series*3 of soft ferrite cores for high-frequency power supplies. The cores are made of Mn-Zn soft magnetic materials that enable the reduction of core losses (energy losses) even in high-frequency environments. Accordingly, they are expected to help prevent performance degradation of servers, adapters, and EV power supplies and power transformers.
- The Group developed a high-power-density technology for on-board chargers (OBCs)*4-5 for installation in EVs and plug-in hybrid electric vehicles (PHEVs). A prototype OBC incorporating this technology operated successfully at a high-output density of 3.8 kW/L (details on page at right).

Wires, Cables, and Related Products

- The Group developed EN wires with improved identifiability and thin-wall three-layer wires that incorporate multilayer simultaneous extrusion molding technology. Here, we used our original formulation technologies to lessen the diameter and weight compared to those in conventional EN wires, thus contributing to saving space and energy.

*1 A general term for electric vehicles (EVs), hybrid electric vehicles (HEVs), and plug-in hybrid electric vehicles (PHEVs)
*2 Moderately quenched steel materials for dies (featuring lower heat treatment costs, shorter delivery time, and no deformation from the quenching process, as no heat treatment is needed)
*3 Received the Environment-, Resource- and Energy-related Components Award at the “CHO” MONOZUKURI (“super” production) Innovative Parts and Components Award 2019
*4 AC/DC converter used to convert AC voltage to DC voltage and charge EV and PHEV batteries
*5 The OBC prototype uses the soft magnetic materials of Hitachi Metals and the circuit technology of the Fraunhofer Institute for Integrated Systems and Device Technology IISB of Germany to achieve both high output and miniaturization.

Open innovation for advances in output and compactness of in-vehicle chargers

The Hitachi Metals Group established the Global Research & Innovative Technology center (GRIT) to create a framework for promoting medium- to long-term research across the entire Group. By emphasizing cross-departmental projects and open innovation through collaboration between the research arm of our business headquarters and GRIT, we aim to create new levels of value. Below, we introduce examples of prototype development through open innovation aimed at increasing the output and miniaturization of in-vehicle chargers, including those of EVs.

■Addressing problems of on-board chargers

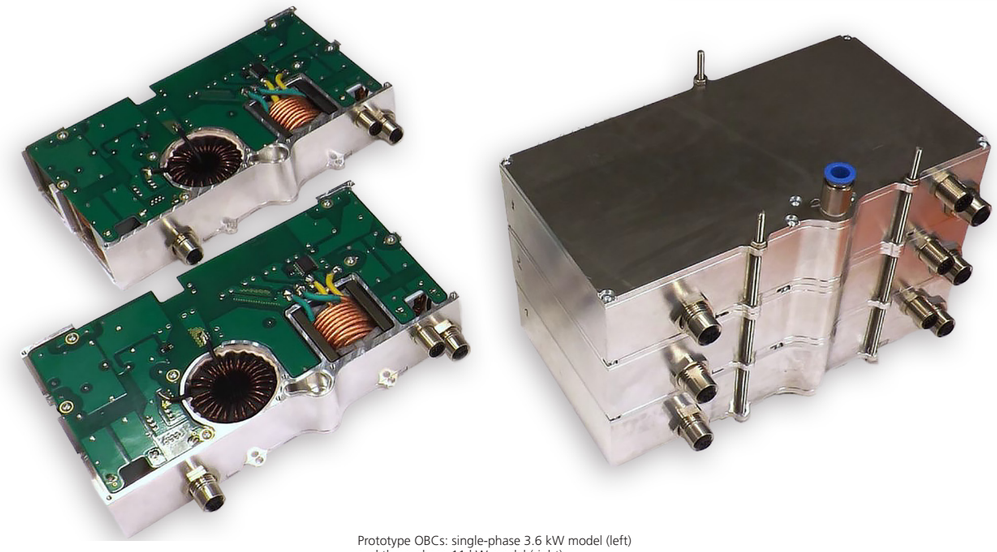
Charging batteries for such things as EVs requires conversion of alternating current (AC) to direct current (DC), and on-board chargers (OBCs), which serve as AC/DC converters, need to have high output to charge batteries in a short time. They also need to be compact to save space inside the vehicle. Since there is a trade-off between high output and the miniaturization of OBCs, achieving both has been a longstanding challenge. As a manufacturer of soft magnetic materials, the Hitachi Metals Group constantly looks for ways to help resolve problems. With the OBC issue in mind, we started working with the Fraunhofer Institute for Integrated Systems and Device Technology IISB (Fraunhofer IISB), the largest applied research institute in Europe.

■ World’s highest levels of output and miniaturization

Together with Fraunhofer IISB, we applied silicon carbide (SiC) to semiconductors and used a combination of our soft magnetic materials—which permit both miniaturization and high-frequency drive—and Fraunhofer IISB’s circuit technology to develop a high-output, compact OBC prototype. In April 2019, we announced our development of an OBC that can independently operate at 3.8 kW/L, which is the world’s highest output density. Moreover, up to six units can be connected in parallel to achieve outputs as high as 22 kW. This type of flexibility will lead to significant reductions in OBC design time and cost. By sharing the data obtained from such open innovation with our OBC-manufacturing customers, we will contribute to the practical application and widespread use of high-output, compact OBCs.

Soft magnetic materials used in OBC prototype

- Section of input/output noise filter
  Common-mode choke coils made with the FT-3K50T (Finemet®) nanocrystal alloy
- Rectifier/power factor correction circuits
  Choke coils made with the HLM50 series of amorphous powder cores
- AC/DC converter
  Isolation transformer (with integrated resonant inductor) made with ML29D low-loss soft ferrite core material



Prototype OBCs: single-phase 3.6 kW model (left) and three-phase 11 kW model (right)