

Examples of Initiatives in Target Areas

EV*-related products

The rapid shift toward electric power is one of the measures being taken to reduce the environmental load of automobiles, and EV production is seen growing by 30% annually on a unit basis. Hitachi Metals is able to use the advanced technologies and *monozukuri* capabilities it has developed over the years in a range of areas that are growing with unlimited potential; in addition to drive motors, these include inverters, batteries, chargers, power semiconductors, and various sensors that are essential to safety and autonomous driving. We see this as a major opportunity, and will work toward contributing to the realization of a low-carbon society together with sustainable growth.

A total supplier of high-performance materials

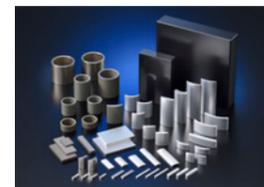
Becoming a core supplier of EV-related products

With powertrains being powered electrically, innovation is being sought not only in drive motors, but also in all major necessary components, including higher output and lighter weight for automotive-use secondary batteries, and brake and handle controls for automated driving. Hitachi Metals is able to supply a total range of various high-performance materials, including magnets for drive motors, inverters and converters, and soft magnetic materials and cladding materials used in secondary batteries. We are therefore accelerating our development and production with the aim of being a core supplier of EV-related products that is also a reliable partner.

Hitachi Metals' products driving EV evolution

Products for "moving"

- NEOMAX® neodymium magnets
- NMF™ ferrite magnets
- Amorphous motor core materials
- Magnet wires for high-efficiency motors



NEOMAX® neodymium magnets



NMF™ ferrite magnets

Products for "storing"

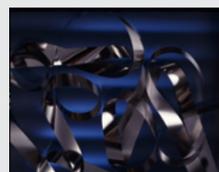
- Cladding current collector for large-capacity lithium ion batteries
- Aluminum battery cases



Lithium battery-use cladding materials



Aluminum battery case



FINEMET® ribbon

Increasing production capacity for FINEMET®

With the aim of smaller sizes and lighter weights for power supply circuits used in equipment with an output of more than several kilowatts, including electric vehicles, railways, and renewable energy systems, drivers need to operate at even higher frequencies. The magnetic steel sheets previously used in high-frequency ranges, however, experience significant iron loss (loss of the energy generated in the iron core) when used in transformers and reactors, causing a loss of electric power that leads to issues including lower efficiency and higher temperatures. In addition, shifting to higher frequencies means that the associated high-frequency noise needs to be addressed. To resolve this, FINEMET®, a nanocrystalline soft magnetic material with high magnetic permeability and high flux density with low iron loss, has proven effective for use as the iron core in equipment including transformers, reactors, and chokes for noise filters. To meet market needs, Hitachi Metals is boosting the capacity of its production line with a planned three-fold increase by the end of fiscal 2018 (compared with fiscal 2017). We are also improving processes in an effort to enhance quality on an individual piece basis.



NEOMAX® neodymium magnets

NEOMAX® neodymium magnets make motors smaller and more efficient

NEOMAX® is a neodymium magnet with superior magnetic characteristics of which Hitachi Metals led the world in developing and launching the mass production. It is widely used in EV powertrains, which need to have high output. At our innovative production line that started mass production in September 2018, extensive automation and the use of the Internet of Things have achieved significant increases in product quality and productivity, in response to increased market demand. In addition, by making Santoku Corporation a subsidiary in April 2018, we have reduced procurement costs for raw materials and concentrated alloy manufacturing and recycling to increase production volume and build an integrated development structure. Going forward, we will focus on reducing the size and increasing the efficiency of motors, and expand and bolster our lineup of high-performance magnets that use less volume of heavy rare earth elements.



Products for "transmitting"

- Nanocrystalline soft magnetic material FINEMET® coils, cores, transformers
- High-frequency low-loss soft ferrite cores
- High-performance amorphous powder cores
- Silicon nitride substrates
- Harnesses for electric parking brakes
- Power cable harnesses for hybrid vehicles



High-frequency low-loss soft ferrite cores



Amorphous powder cores

Products for "reducing weight"

- High-strength, high-toughness ductile cast iron
- OMEGA KNUCKLE®
- SCUBA™ fashionable aluminum road wheels
- Aluminum motor housings
- Tools for friction stir welding (FSW)
- NEOMAX® neodymium magnets



OMEGA KNUCKLE®



Aluminum motor housing



Harness for electric parking brakes



Power cable harness for hybrid vehicles



Magnet wires for high-efficiency motors

Expanding magnet wire business in anticipation of robust EV demand

The magnet wire business, which includes magnet wires for drive motors, is growing from the use of HiFC™ high-performance pure copper and the introduction of innovative production lines. HiFC™ was developed by Hitachi Metals by adding trace amounts of titanium to copper, which controls the actions of the impurities oxygen and sulfur, while properties including conductivity, flexibility, and weldability are enhanced. Using HiFC™ for motor magnet wires increases productivity in manufacturing the motors while also reducing their size and weight and increasing their efficiency and reliability. In addition, we have introduced innovative production lines in Japan and Thailand to accelerate *monozukuri* and expand the magnet wire business.



Silicon nitride substrate with high thermal conductivity for use in power semiconductor module

Silicon nitride substrate makes dramatic improvement in cooling properties for power modules

Power modules efficiently transform and control electric power, and their use is spreading rapidly in control components for electric vehicles, rolling stock, and motors for industrial machinery. In addition to insulation, insulating substrates used in power modules need thermal conductivity for the efficient transfer of the heat emitted from power semiconductors, and the sophisticated mechanical property of resistance against the stress created by the temperature cycle. In addition, the use of silicon carbide (SiC) semiconductors as next-generation power semiconductors is seen increasing going forward, leading to heightening requirements for high thermal conductivity and mechanical properties in insulating substrates. The silicon nitride substrate developed by Hitachi Metals has both high thermal conductivity and mechanical properties. Use of this substrate can be expected to reduce the size and lower the cost of cooling mechanisms in power modules. The use of SiC semiconductors could also make it possible to operate at higher temperatures.

* EV refers to electric vehicles including hybrid electric vehicles (HEV) and plug-in hybrid electric vehicles (PHEV).