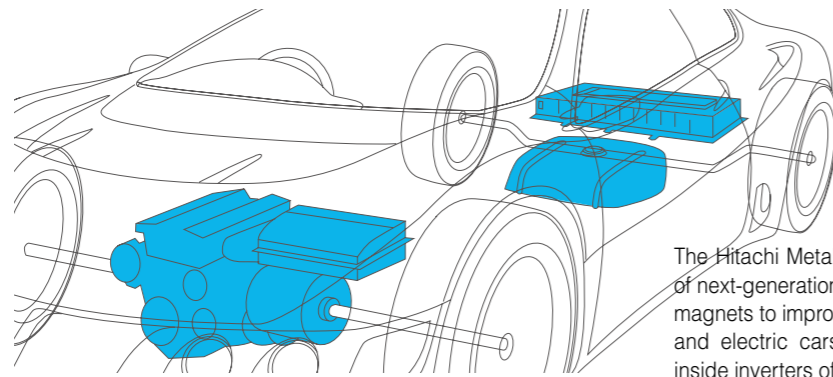




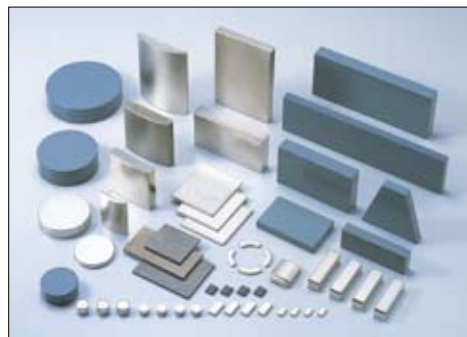
# Hybrid cars & Electric cars



The Hitachi Metals Group contributes to the development of next-generation automobiles by consistently developing magnets to improve the drive motor performance of hybrid and electric cars, soft magnetic materials mainly used inside inverters of these automobiles and other automotive components and materials.

## Components and Materials Peripheral to the Drive Motor

### “NMX Series” Nd-Fe-B Sintered Magnets [NEOMAX Company]



NEOMAX®

Nd-Fe-B magnets with superior magnetic properties are used in the drive motors of hybrid and electric cars. We have a variety of products in our lineup including “HILOP™,” a unique process that reduces residual oxygen by wet forming in the magnetic field, and “NEOMAX®,” a dry, high-performance material including high heat-resistant materials. These materials are selectable according to the operating environment and help maintain a normal temperature in the severe environment surrounding the engine system.

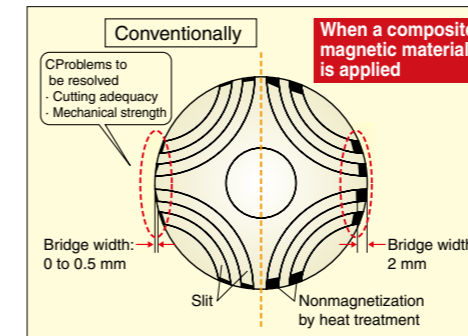
These magnets are suitable for the drive motors of hybrid and electric cars, as well as alternators, starter generators and power generators.

\* HILOP™ (Hitachi Low Oxygen Process)

The world's first wet forming, mass-production system developed by Hitachi Metals in 1995, or products produced using this process.

\* NEOMAX® is a registered trademark of Hitachi Metals, Ltd.

### Double phase magnetic materials [Specialty Steel Company]



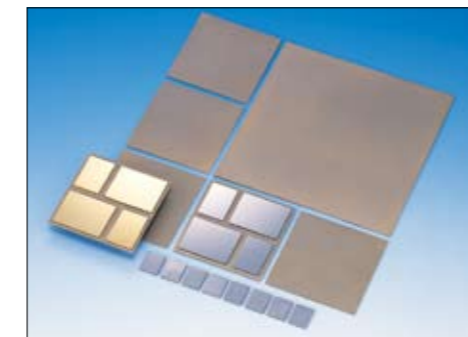
Conceptual diagram of a motor core using a composite magnetic material

Double-phase magnetic materials have both ferromagnetic areas and nonmagnetic areas inside a single material. Their single-piece formation increases mechanical strength and reliability and, in combination with a magnet, makes circuit design highly efficient. The maximum specific permeability is 100 μm at a strong magnetic area and 1.01 μm at a non-magnetic area. Customers can select either the non-magnetic base type or the ferromagnetic base type.

Suitable applications include the cores of reluctance motors and motor generators for hybrid cars, electric solenoid valves and electric power steering components to improve the operating efficiency of these equipment and devices.

## Inverter Components and Materials

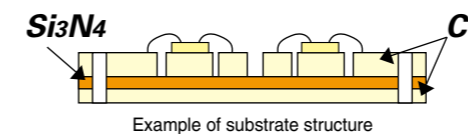
### Si<sub>3</sub>N<sub>4</sub> Insulated Substrates Used in Power Semiconductor Modules [New Business Development Center]



Si<sub>3</sub>N<sub>4</sub> Insulated Substrates

These insulated substrates are used in power semiconductor modules such as inverters and rectifiers. Silicon nitride substrates are now focused due to high strength and good thermal conductivity. Compared with conventional aluminum nitride (AlN), this material boasts high strength and toughness, resulting in improved reliability in temperature-resistant cycle tests and extensive design flexibility for heat dissipation in good thermal conductivity. Accordingly, the assemble structure of power semiconductor modules can be simplified such as abridgment of the base-plate. The substrates can use copper wiring rather than aluminum wiring.

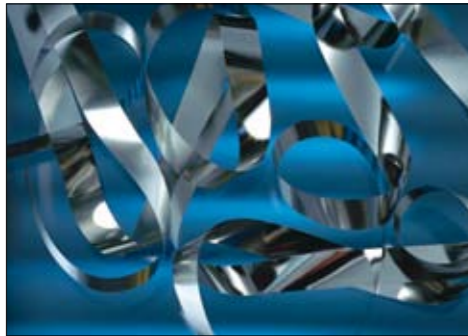
These substrates are advantageous in a harsh operating environment with high temperature and vibrations with outstanding insulating and heat-dissipating characteristics.



Example of substrate structure

### “FINEMET®” Nanocrystalline Soft Magnetic Material

[Information System Components Company]



FINEMET®

FINEMET® is a new type of Fe-based soft magnetic material.

Previously, metal crystalline materials with larger crystal grains were thought to have better magnetic characteristics. Hitachi Metals invented a completely new material in which extremely fine crystal grains (at around 10 nm) considerably raise the magnetic characteristics. This finding has overturned the prevailing belief. Hitachi Metals named the material FINEMET. Taking advantage of high saturation flux density, high permeability, low core loss and low magnetostriction, the material helps to make various magnetic components for electronic devices lighter and increasingly compact, energy saving and low noise.

\* FINEMET®

This name derives from the combination of the terms “Fine” and “Metal”, which indicate the material’s features of being formed with fine crystal grains and having excellent magnetic characteristics.

### “Metglas®” Amorphous Soft Magnetic Material

[Soft Magnetic Materials Company]



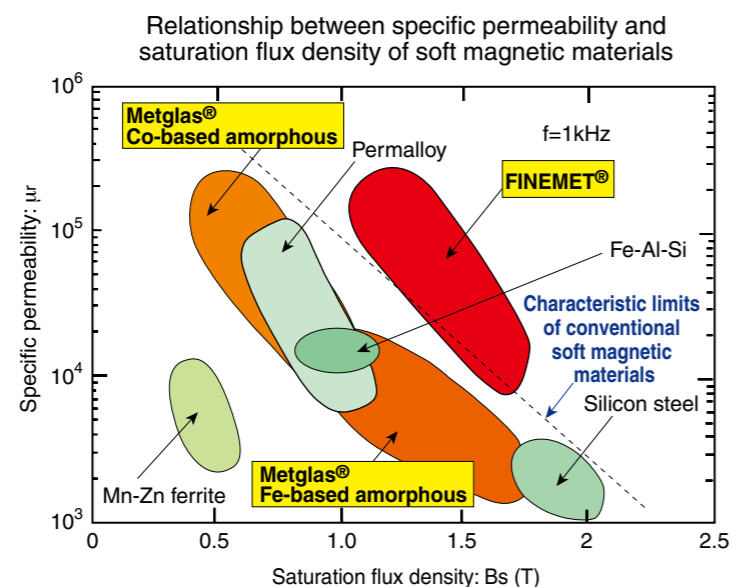
Co-based amorphous soft metal material

#### ● Co-based amorphous soft magnetic material

The Co-based amorphous soft magnetic material, with almost zero magnetostriction, high permeability and low core loss, is suitable for such applications as magnetic snubber cores to suppress surge current and magnetic shielding sheet.

#### ● Fe-based amorphous soft magnetic material

The Fe-based amorphous soft magnetic material features high saturation flux density and lower core loss than that of conventional crystalline soft magnetic materials, such as silicon steel. This makes components more compact and lightweight and results in lower core loss in such applications as the choke coils used in DC-DC converters and the normal-mode choke coils for EMC filters.



### “FM-VL series” Common Mode Choke Coils

[Information System Components Company]



Common-mode choke coils (single-phased FM coils)

These Common Mode Choke Coils make the most of the high permeability and stable temperature characteristics of FINEMET®. These choke coils are suitable for the line noise filters of various inverter devices, switching mode power supplies and signal lines. They feature strong noise suppression for a wide frequency range and small characteristic variations against temperature change, enabling smaller and lighter choke coils.

### “FT-3KL F series” Zero-Phase Reactors (Common Mode Choke Cores)

[Information System Components Company]



Zero-phase reactors (Cores for common-mode chokes)

These Zero-Phase Reactors also make the most of the high permeability and stable temperature characteristics of FINEMET®.

The zero-phase reactors are suitable for the radio noise and line noise filters of various inverter devices, switching mode power supplies and signal lines.

### “MICROLITE®” Power Inductor Cores

[Information System Components Company]



MICROLITE® cores

The MICROLITE® Power Inductor Cores use Fe-based amorphous materials of high saturation flux density and low core loss. Three types with permeability of 100, 245 and 270 are available. They can be used in environments that are exposed to considerable vibrations and/or temperature change as power inductors for the smoothing of various power supplies and voltage conversion of DC-DC converters. In addition, they are suitable for manufacturing more compact coils with lower core loss.

## DC-DC Converter Components and Materials

A DC-DC converter converts DC voltage to ensure efficient delivery of voltage from batteries and/or fuel cells to various electrical components and drive motors inside a car. Higher efficiency, more energy conservation and compact size are strongly requested for DC-DC converters, requiring material manufacturers to furnish more efficient materials with lower power loss.

### Soft Ferrite

[Information System Components Company]



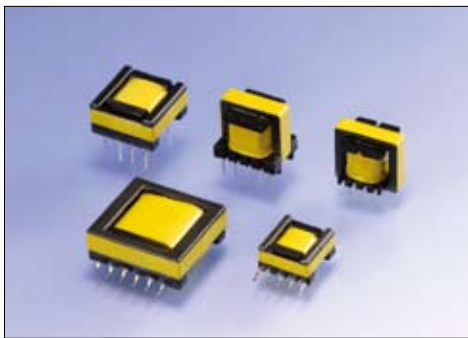
Various soft ferrite products

Soft ferrite is an iron-oxide-based soft magnetic material. Different from FINEMET®\* and other soft magnetic materials such as amorphous, this material features high electrical resistance and outstanding magnetic properties in the high-frequency range although saturation magnetic flux density is slightly low.

\* FINEMET® is a registered trademark of Hitachi Metals, Ltd.

### Transformers for DC-DC Converters

[Information System Components Company]



Transformers for DC-DC converters

These transformers are specially developed for DC-DC converters that convert DC voltage from a battery according to the needs of various electronic devices. Soft Magnetic Materials Company supplies high-performance transformers that efficiently conduct voltage conversion under severe car body environments against heat and vibration.

These transformers are also used for the lighting circuits of metal halide lamps.\*

\* Metal halide lamp

This type of lamp is increasingly popular with such features as high luminance, energy-saving, long life and easy-to-see light with colors similar to those of solar light.

### Cut Cores for Power Choke (FINEMET® F3CC series and Metglas® AMCC series "POWERLITE®")

[Information System Components Company]



Cut cores for power chokes

Compared with conventional silicon steel cut cores, these cut cores can largely reduce core loss. Two series of cut cores are available. One is "POWERLITE®," which uses a Fe-based amorphous material that excels in superimposed DC characteristics due to high saturation flux density and is advantageous for compactness. The other is "FINEMET® F3CC series," which features low audible noise and low core loss due to smaller magnetostriction. These cut cores are easily manufactured in large sizes, which makes them suitable for applications that require large output capacity, such as power chokes for pressurizing DC-DC converters to be used between a battery and an inverter. (The maximum continuous operating temperature is 155°C.)