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Hitachi Metals, Ltd.

Hitachi Metals Announces Introduction of New Soft Ferrite Core Materials with Outstanding High-Frequency Characteristics

Hitachi Metals, Ltd. is pleased to announce its introduction of ML95S and ML90s—two soft ferrite core materials distinguished by outstanding high-frequency characteristics—and a mass production system to supply those. The use of these materials is anticipated to be a key element in further downsizing and energy savings related to components for network equipment, automobiles and smartphones.

1. Background

Recent years have brought major advances in cloud services and the business of big data. Servers and other network equipment with increasingly larger capacity and higher speed have been part of that progress. Heightened environmental awareness, meanwhile, has fueled keen demands for more pronounced moves toward energy savings. Data centers are a particular case in point. These key facilities support network services, and there have been calls for network equipment that is smaller size and produces less waste heat, which will help curb air-conditioning costs and realize greater energy efficiency. To address these requirements, technological progress continues to raise the frequency and current of the semiconductors used in server power sources. Solutions are also needed for the transformers, inductors and other passive components those systems use.

For transformers and inductors, shifting from operation in kHz domain switching frequencies to the high-frequency range of several MHz has tended to significantly raise core loss[1] in materials of the cores that are their key elements. The results have included lower power conversion efficiency and greater generation of heat. Since the heat produced is prone to radiate and negatively affect surrounding components, a need has emerged for cooling capabilities to stabilize system operation.

Addressing this situation required the development of core materials that offer low core loss at high frequencies (in the MHz range) and improved resistance to heat generation.

2. Outline

Our new ML95S and ML90S soft ferrite core materials are created from a manganese-zinc ferrite (Mn-Zn) material with outstanding capacity in lowering core loss in high-frequency domains (in the range of 0.5 to 5 MHz). Studies also targeted the potential use of nitrogen-zinc (Ni-Zn) ferrite materials for this purpose.

Ultimately, the use of Hitachi Metals' original powder metallurgy and heat-treatment technologies paved the way for the development of Mn-Zn ferrite materials with higher saturation magnetic flux

Photo: ML95S and ML90S—ferrite core materials with high-frequency characteristics

density[2] than their Ni-Zn counterparts. The resulting materials also excel in low core loss characteristics in high-frequency domains. Moreover, since this material achieves outstanding low core loss in high-temperature environments approaching actual use conditions (the 80 to 100˚C range), it effectively lowers power consumption and curbs heat generation.

Use of these products makes it possible to mount stable responses when moving into high-frequency, large-current operation in transformers and inductors, raising hopes for network equipment that is smaller and offers enhanced energy savings. The conceivable scope of applications includes automobile electrical components, mobile terminals and other products, promoting the mission to contribute to redoubled downsizing and energy savings in a wide range of electronic parts

Last year, Hitachi Metals announced its introduction of MB20D—a soft ferrite core material engineered to yield superb characteristics suited to high-temperature environments. The addition of ML95S and ML90S to our soft magnetic materials lineup will empower the company to target an even broader range of customer needs. Hitachi Metals is set to continue the quest to perfect materials that draw out the properties of raw resources, contributing to smaller and lighter electronic components with higher efficiency and reliability.

■ ML95S Main Features

This material effectively keeps core loss to low levels at frequencies of 500 kHz to 2 MHz, especially when operating in high magnetic flux density domains of 50 mT and above.

(Reference: Major reduction in core loss to levels approx. one-third of the existing Hitachi Metals MB28D product line at a frequency of 1 MHz and magnetic flux density of 75 mT [100˚C].)

■ ML90S Main Features

This material effectively keeps core loss to low levels at frequencies of 1 to 5 MHz, especially when operating in magnetic flux density domains of 50 mT and below.

(Reference: Major reduction in core loss to levels approx. one-fifth of the existing Hitachi Metals MB28D product line at a frequency of 2 MHz and magnetic flux density of 50 mT [100˚C].)

3. Production Location

Production bases: Hitachi Ferrite Electronics, Ltd., Hitachi Metals Hong Kong Ltd. (Pan Yu Factory)
Mass production system: Fully in place

4. Patent

Two applications pending

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Supplementary Explanations

■ **Properties of ML95S and ML90S High-Frequency Ferrite Core Materials**

		ML95S (Newly developed)	ML90S (Newly developed)	MB28D (Existing product)	NL80S (Existing product)
Core loss Frequency: 1 MHz Flux density: 50 mT	100˚C	240 kW/m^3	200 kW/m^3	1,500 kW/m^3	2,800 kW/m^3
Core loss Frequency: 1 MHz Flux density: 75 mT	100˚C	1,100 kW/m^3	1,700 kW/m^3	3,800 kW/m^3	—
Core loss Frequency: 2 MHz Flux density: 50 mT	100˚C	1,900 kW/m^3	1,300 kW/m^3	6,800 kW/m^3	7,500 kW/m^3
Saturation magnetic flux density	100˚C	430 mT	430 mT	440 mT	290 mT
Initial permeability		1,100	900	2,800	800
Electrical resistivity		5.0 Ωm	4.5 Ωm	8.0 Ωm	10^6 Ωm
Curie temperature[3]		280˚C	280˚C	240˚C	210˚C

1 “Core loss” refers to the loss of energy when magnetic cores are placed in magnetic fields of alternating currents at specific frequencies. Higher core loss leads to higher energy loss.

2 “Saturation magnetic flux density” is the value that expresses the strength of magnetic force in materials, and is a standard measurement for the performance of magnetic materials. The degree of magnetization upon magnetizing materials is referred to as magnetic flux density, and a higher value leads to the downsizing of cores. Saturation magnetic flux density indicates the limit of magnetization upon magnetizing of materials.

3 “Curie temperature” refers to the transition temperature when a ferromagnetic substance changes into a paramagnetic substance, or when a ferroelectric substance changes into a paraelectric substance.