

Required Magnetic Material Excited by Power Electronics Equipment

Keisuke Fujisaki
(Toyota Technological Institute)

Energy magnetic material of soft one as well as hard one is used in electrical energy circumstance in order to obtain high magnetic flux density in small external magnetic field. Electrical motor, transformer and inductor are its application. Because of power semiconductor development, power electronics technology is widely applied to electrical energy. So power magnetic material is said to be excited by and used in power electronics equipment.

One of the most important key technologies in power electronics is a switching operation. By using it, the energy consumption in the power semiconductor becomes small, and then the electrical energy conversion such as AC to DC or DC to AC in any voltage and any frequency can be realized in high efficient and in high responsibility. So an electrical motor excited by inverter, a kind of power electronics equipment, makes it possible to rotate in variable velocity. Now the motor drive system can be applied to all the transportation vehicle such as automobile, ship and airplane.

However, this tendency of power electronics excitation makes energy magnetic material in a new operated condition. Usually, it is excited in commercial frequency without harmonics components basically as far as it is used in connection with electrical energy network directly. In power electronics circumstance, an operating frequency becomes high and electrical current and voltage has harmonics components. High frequency operation is required to make the electrical components small, and harmonics components always generates because of the switching operation of power semiconductors.

This tendency has been already realized in small electrical energy equipment such as mobile phone or notebook personal computer. The operating condition is MHz to GHz frequency in mW to W electrical power. However, the new tendency as transportation revolution and new material of SiC and GaN requires a new operation condition as kHz to MHz in kW to MW, which can be realized by power electronics research. New magnetic material is strongly expected.

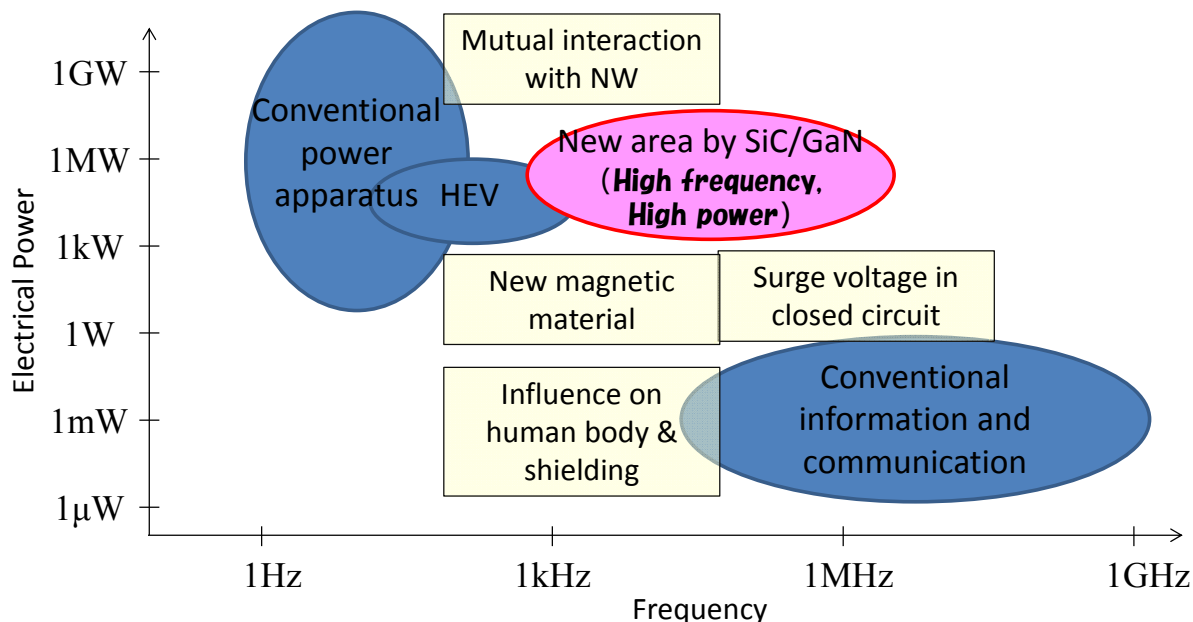


Fig. 1. Required magnetic material by power electronics development for new transportation system.

Reference

- 1) K. Fujisaki, "Required Magnetic Property for Energy Magnetic Material," Oct.29 - 31, 2014, 3rd International Conference of Asian Union of Magnetism Societies (IcAUMS), A1 - 03, 2014.10.
- 2) T. Heidel : "ARPA-E Initiatives in High Efficiency Power Conversion", APEC (Applied Power Electronics Conference and Exposition) 2014, Plenary Session Presentations, Fort Worth, (2014).
- 3) J. W. Kolar, "Future Challenges for Research and Teaching in Power Electronics," Presentation held at the 14th International Conference on Optimization of Electrical and Electronic Equipment (OPTIM 2014), Brasov, Romania, May 22-24, 2014.