

## Requirement of magnetic material for high frequency and high power excited by power electronics

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Electric energy is often converted various energies such as mechanical, light and heat ones due to high responsiveness and high conversion efficiency, and 43% of energy in Japan is consummated as electric energy. The power consumption related to power electronics technology has been dramatically increased recently, and it is expected that 80% of the electric energy will be consumed by the power electronics technology in 2030.

In power electronics technology, we can generate electric power with any voltage and any frequency by using power semiconductors. The markets related to power conversion have been being expanded by downsizing and an increase in power capacity using high-frequency driving. One of the serious factors to prevent expanding the markets are magnetic materials for high-frequency driving. For example, the weight of magnetic devices such as inductors and transformers for the mW to MW class account for 30 - 50% of the total weight. Although the increase in an operating frequency is effective to reduce size of magnetic devices, efficiency for the power conversion typically decreases since the magnetic loss of the magnetic materials increases. A cost analysis for a 20 kVA-uninterruptible-power-supply points out that the cost of inductors for filters is 44% of the total cost, and this value is larger than that for the power semiconductors and the storage capacitors.

Thus, the magnetic materials for high-frequency driving are the bottleneck of expanding the power electronics technology in terms of the difficulties of the reductions in size, loss, and cost. Although the widespread of power semiconductors with high voltage resistant such as GaN and SiC enables to increase the power capacity, we need to develop mass-production technology of the magnetic materials.

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