

## Experimental Study on Electrical Characteristics of Advanced Unipolar Power Electronics Devices for High Current Operation of AC/DC Converter

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Large capacity power supply is required for energizing the magnetic field coil system of nuclear fusion experimental machine in future, and high efficiency and low operational loss of such power supply are important issues. Especially, for high current operation of large capacity power supply, the switching power electronics device of AC/DC converter for power supply should be more efficient and have lower on-state resistance than conventional one. Recently, some advanced power electronics devices have been developed, which are unipolar power device based on crystallized SiC material or super junction type modified unipolar power device based on crystallized Si material.

Concerning the efficiency improvement of AC/DC converter, the temperature dependence of electrical characteristics of switching device is the key issue on operational loss reduction. On-state resistance and allowable operational temperature of switching device are directly related to the operational loss of AC/DC converter. The former one is the main parameter of conductive loss, which is dominant one of the operational loss of high current AC/DC converter, and it is effective to reduce the conductive loss for efficiency improvement. The latter one is related to the cooling capability of cooling equipment, which is a main auxiliary component of large capacity AC/DC converter. The temperature dependence of on-state resistance of SiC-based or Si-based advanced unipolar power electronics device will be expected to reduce the conductive loss and to simplify the cooling equipment of AC/DC converter. The allowable operational temperature of SiC power device is higher than that of Si power device, therefore it is also expected to minimize the cooling capability. Such electrical characteristics of SiC-based or Si-based advanced unipolar power electronics device will contribute to reduce the operational loss and to improve the operational efficiency of AC/DC converter.

With the experimental results of measurement for present SiC-based and Si-based advanced unipolar power electronics device, the effect of their electrical characteristics is mainly discussed on efficiency improvement. And, the temperature dependence of their electrical characteristics will be also mentioned in comparison with conventional Si-based power device.