Abstract:

Current Status and Future Perspectives of Wide Bandgap Semiconductor Devices and Applications

Power semiconductor devices are the essential components determining the efficiency, size and cost of the power electronic systems for energy conditioning. Advancements in power devices have revolutionized power electronics, and today's market offers a wide spectrum of devices intended for different applications. Despite the advancements, Si power devices are approaching their performance limitations. Wide bandgap materials such as SiC and GaN are attractive semiconductors that enable power devices to operate at higher efficiency, high power density and higher temperature. This presentation will give a review of the progress and significant achievements in WBG power devices, modules and power electronics applications. Various power devices on SiC and GaN have been implemented in the power systems from low power level such as laptop charger to the high power level of Megawatts. Significant benefits in reducing the system cost, improving system reliability and efficiency have been successfully demonstrated in many projects, and the detail of inserting SiC- and GaN-based power devices in power systems will be reviewed in detail. SiC power devices such as Schottky diodes and MOSFETs have been commercially available with the voltage range of 650V-1700V. The evolution of technology development in both devices will be investigated thoroughly from the improvement in the performance, reliability and the cost reduction. There are two MOSFET structures are being developed: planar gate MOSFET and trenched gate MOSFET. The pros and cons of both MOSFETs will be outlined with the focused areas such as process complexity, performance assessment and reliability for future development. Currently the major barrier for wide bandgap power devices, especially for SiC power MOSFETs, to be widely adopted in the power electronics is the high lost comparing to the Silicon counterparts. In this presentation, the current cost parity of wide bandgap power devices and future perspectives for the technology development will be discussed.