Electric current dependence on self-cooling device consists of silicon wafers connected to power MOSFET

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Silicon semiconductor power devices that include metal oxide semiconductor field effect transistors (MOSFETs), insulated gate bipolar transistors (IGBTs) and central processing units (CPUs) are used in a daily life to give us modern life in the present time. When we use the electrical equipment incorporating these devices, the improvement of heat removal or cooling is one of the most important issues because they will not function correctly if they are operated at temperatures above 423K. The self-cooling device has been developed by combining the commercial n-channel power MOSFET and single-crystalline silicon wafers in order to improve heat removal or cooling of the MOSFET. The time dependence of the temperature distribution in the self-cooling device by using infrared thermography is measured to estimate both the conventional thermal conduction and the Peltier heat flux. We find that the average temperature of both the upper and the lower side on the MOSFET with the n-type or the p-type silicon wafer is cooled down with increasing the electric current from 41A to 45A. This certainly warrants future work on the improvement of the measurement condition. Nonetheless, this fact strongly indicates that the self-cooling effect increases with increasing the electric current and the silicon wafer is one of the candidate materials for use in the self-cooling device.