

Heat Removal of the Coaxial Transmission Line in the ICRF Antenna

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The RF resistance of a transmission line generates heat and thus increases the temperature of a wall in conductors. So, an active cooling of a transmission line is needed for a long pulse operation of the ICRF (Ion Cyclotron Range of Frequency) antenna system. A cooling loop was constructed in order to cool the inner and outer conductors of a coaxial transmission line, and it consisted of a water-cooled heat exchanger, a 3 kW gas blower and a 5 m transmission line. Also, a gas diffuser was attached to the inlet of the heat exchanger to increase its heat removal rate. A pressurized air of 0.2 MPa was actively circulated in the closed loop between the inner and outer conductor. The measurement systems; IR thermometer, thermocouples, vortex-typed flow meter, and RF voltage probes, are equipped in the loop. The temperature of the inner conductor was measured by using an IR thermometer with a ZnSe window port in the outer conductor. The cooling efficiency of the heat exchanger was simulated by using the CFX code to compare its calculations with the results of experiments. The conductor temperatures were measured by varying the flow rate of the circulating gas and the coolant rate of the heat exchanger. As a result, the active cooling experiments show that a gas cooling is effective for a heat removal from the transmission line, and the inner conductor temperature was reduced significantly with the heat exchanger and gas diffuser.