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Optimal operating conditions of YBa2Cu3Oy HTS diode with a PrBa2Cu3Oy buffer layer

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One of the problems with a superconducting magnet is heat leak from the external environment to the inside of the cryogenic devices. In order to suppress the heat leak, the wireless charging has been proposed. Therefore, superconducting diode is expected as a novel rectifying element operating at cryogenic conditions [1]. In our previous study, we reported that YBa2Cu3Oy(YBCO) films grown on PrBa2Cu3Oy (PrBCO) buffer layers showed an asymmetric critical current Ic for current polarity which was enhanced by the small lattice strain [2]. In this study, we investigated the asymmetric Ic of superconducting diodes at various magnetic fields and temperatures, and investigated the optimal operating conditions toward the superconducting magnet applications.

The YBCO/PrBCO films were fabricated on IBAD substrates using the pulsed laser deposition method. Current-voltage characteristics including the reverse current were measured at 0-10 T and 10-88 K at High Field Laboratory for Superconducting Materials (HFLSM). The asymmetricity is defined by the ratio of the difference and average of the Ic for different current directions.

The asymmetricity had a peak of the magnetic field dependence at 0.1-0.2T, which is defined as a peak field. The peak field increased as the temperature became lower. It showed a peak of the temperature dependence at 70 K with the maximum value of 105.3 %. We will discuss the optimal operating conditions of the YBCO superconducting diode grown on PrBCO buffer layers toward the wireless power transfer superconducting magnet.

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Reference

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