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Suppression of Damages on Cathodes in the Negative Ion Sources for the Stable NBI System

Protection system of cathodes from local discharge has been developed for the high power and stable negative ion source used in the heating system of ITER and JT-60SA. Discharge marks on the cathode indicate that this discharge occurs not only to anode walls but also plasma, so-called unipolar discharge. The critical issue is that the local discharge increases with cesium seedings to enhance the negative ions. To minimize damage on the cathode, a fast cut-off system of discharge current has been developed by combining Field Programmable Gate Array (FPGA) and IGBT switch and was applied to protect the filament cathode in the large negative ion source with 1.2 m long. The growth rate of local discharge was independent of the discharge power and varied from 150 to 400 mA/ μ s. However, local discharge with an energy less than 1.3 J did not cause remarkable damage on the filaments, corresponding to the cut-off time of 280 μ s. This system can be applied to any cathode in the ion sources.

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