§29. Construction of RF GLow Discharge Cleaning System

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An RF system was constructed to assist DC glow discharge for cleaning of the first wall, and to improve the cleaning efficiency. The motivations to construct this system are : 1) to reduce the breakdown voltage, 2) to get more uniform discharge along the torus and 3) to perform the discharge cleaning under the condition that toroidal magnetic field of a few tens of Gauss exists.

We need to feed about 130 mTorr of He gas to get breakdown at 2 kV, the maximum voltage available by DC glow discharge power supply. After glow is initiated, the He gas is pumped out to 10 mTorr or less. During this process the turbo-molecular pump is often switched off because of heavy gas load. When the pressure of He gas is relatively high, i.e., several tens of mTorr or higher, intensity of light in glow discharge is locally around the anode, and not uniform along the toroidal direction. In JIPP T-II U system, power supply for the toroidal magnetic coil is flywheel motor generator that is exited 2 second in every 5 minute. Because of the residual magnetization, the generator feeds a small current continuously to the coil even when it is not exited. With the influence of the toroidal magnetic field, the breakdown voltage of DC glow discharge becomes higher and toroidal uniformity becomes worse. This makes the glow discharge cleaning between shots difficult.

The antenna for the RF system is made of a carbon plate the size of which is 50 f x 29 mm and set at UP-position of port No. 3 (Figs.1 and 2) . While the electrode for DC discharge is placed at Horizontal-position of port No. 2 . The RF power from the signal generator is amplified through two stages of wide band amplifier and a tuning power amplifier. The matching circuit is composed of a vacuum variable capacitor and an air core coil. The matching box and vacuum feed through are connected with a coaxial cable of RG/17U.

We could send rf power of 110 W continuously into the DC glow discharge plasma (20 mTorr He,

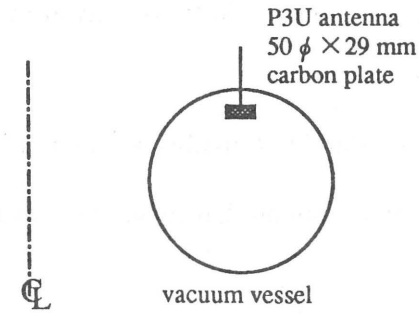

Fig. 1 Schematic drawing of RF antenna for glow discharge cleaning.

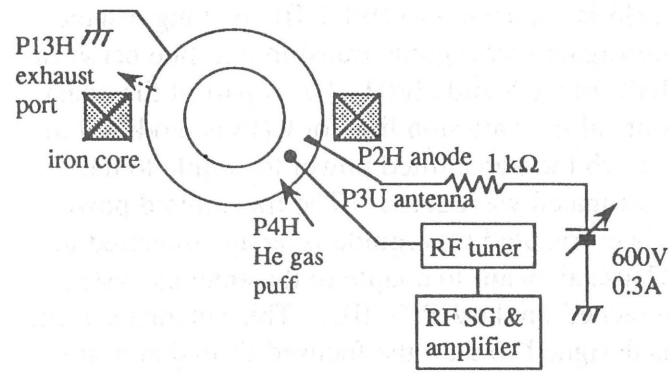

Fig. 2 Schematic drawing of glow discharge cleaning system in JIPP T-II U.

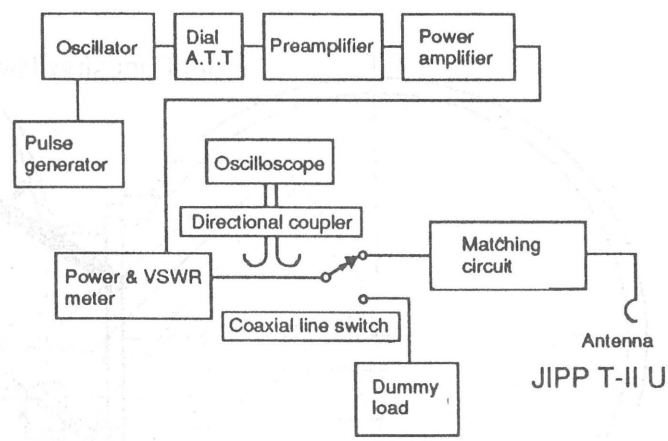

Fig. 3 Block diagram of RF system for glow discharge cleaning.

discharge current 0.3 A) , where RF frequency is 16 MHz and V.S.W.R. = 1.2. In case of boronization, glow discharge current is apt to be unstable. With a help of 110 W level of RF, its stability was improved.