Long pulse H^- beam extraction with a RF driven ion source with low fraction of co-extracted electrons

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IPP Garching is developing H^-/D^- RF ion sources for the ITER neutral beam system using three test facilities. On the MANITU testbed (multi ampere negative ion test unit) the experiments are focussed on long pulse H^-/D^- beam extraction for up to 3600 s with a 30 l prototype source with an extraction area of 204 cm^2. The negative ion production is based on surface conversion of atoms and positive ions on thin Cesium layers.

After both the source design and the RF power supply have been successfully upgraded for long pulse operation, the first 3600s pulse with H^- beam extraction has been performed, showing stable ion and electron currents [1].

Suppression of the co-extracted electron current, which was an issue in these long pulses and limited the RF power, has now been achieved. The electron current was significantly lowered and the ion current increased after coating of the inner parts of the source with molybdenum. This prevents sputtering of copper from the surfaces and in this way improved the Cs conditions on the plasma grid. By an appropriate choice in bias current to the plasma grid and of the magnetic filter field strength the electron current can be regulated in long pulses without loss of ion current to low values consistent with the ITER requirements.

The operation at a RF power higher than 70 kW was hampered by breakdowns at the coil. To solve this problem various insulation gases and fluids have been tested in order to improve the insulation of the RF coil.

In this paper the improvements of the source performance by electron suppression and by higher operation reliability at high power with hydrogen and deuterium are reported.

References

[1] W. Kraus, Rev. Sci. Instrum. 79, 02C108 (2008)

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