§5. An 100 keV Operation of a Vacuum-immersed H^- Ion Source

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A Large vacuum-immersed H^- ion source has been developed on the negative ion based neutral beam teststand which is based on a proposed neutral beam injection systems for the LHD. The vacuum-immersed source must be featured by a capability of high voltage insulation (i.e., ideal insulator in vacuum), and a simplified mechanical structure in addition to an improvement of stripping loss compared with those for ion source in the atmosphere. However, the operation of the vacuum-immersed ion source with a high acceleration energy and a long pulse was difficult in the first place. The cause for this was considered that the existing low density plasma near the ion source (i.e., parts with high potential) would induce high voltage breakdown in the vacuum vessel.

In order to solve the problems, a shielding baffle plate foe the charged particles was installed at the grounded electrode of the accelerator, as shown in Fig.1.

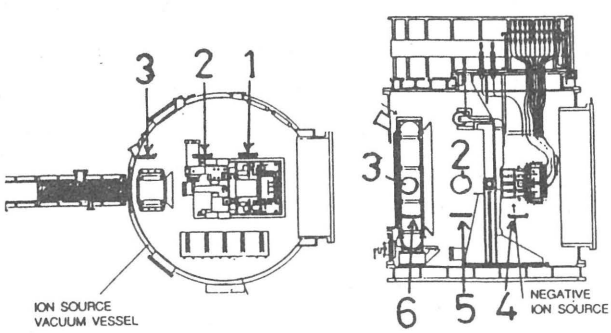

Fig.1. Vacuum-immersed H^- ion source with a baffle plate in the ion source vacuum vessel.

A new magnetic filter of Type I in the multicusp plasma source was also applied to aim a reduced electron beam component. Beam conditioning characteristics were improved and beam with an energy up to 102 keV and a current of 0.55 A (H-) was achieved for a pulse duration up to 0.29 sec. without high voltage breakdown, as shown in Fig.2. Electron beam component which was extracted together with H^- ion was found to be reduced much.

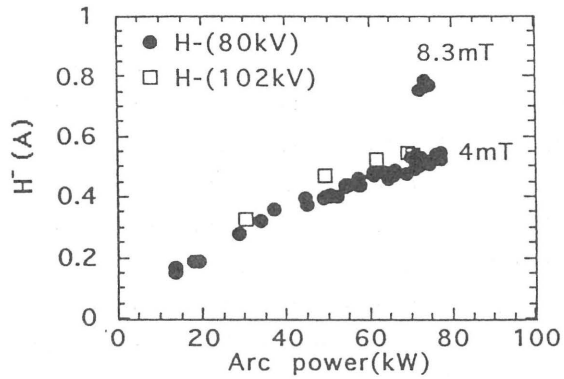

Fig.2 H^- ion current as a function of arc power without high voltage breakdown. Beam extraction area is about 22 x 22 cm^2.

It was confirmed that H- current was increased by at most twice when cesium was seeded to increase a production efficiency of the negative ions, as shown in Fig.3.

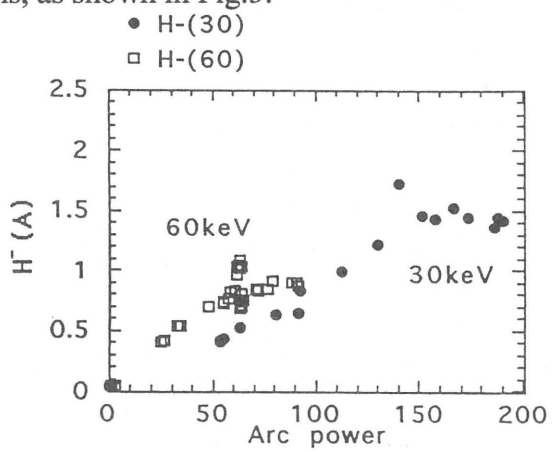

Fig. 3 H- ion current as a function of arc power with cesium seed.

We succeeded basically in achieving a level of ampere beam of H- ions with an energy of 100 keV in the vacuum-immersed source. To get a higher current with a long pulse, it is necessary to improve the way of cesium deposition into the plasma source.