

Development of ECR Negative Ion Sources - Effects
of Argon Addition for ECR Plasmas[†]

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Negative ion sources for neutral beam injection (NBI) systems are extensively studied for future large experimental fusion devices. In the present, the source plasma is generated by DC arc discharge where a hot filaments act as cathode. The lifetime of ion sources is limited to several hundred hours due to erosion and fatigue of the cathode filaments. Thus, extending the life of ion sources is required for future NBI systems. A microwave-discharge ion source and an RF-driven ion source are promising as long-lifetime ion sources because they have no filaments.

We have studied high-density plasma production and high efficiency H^- production in ECR discharge plasmas with line-cups-type and ring-cups-type magnetic fields, which are different ECR resonance conditions. According to our previous results [1][2], in the extraction region, electron temperature T_e in ECR plasma is higher than that in DC plasmas. This result indicates that, in controlling plasma parameters, the effect of magnetic filter for ECR plasmas is weaker than that for DC plasmas. Also, electron density n_e in the source region is much lower than one in DC plasmas. Thus, extracted H^- current from ECR plasmas was small. According to these results, with adding Ar to H_2 discharges for enhancement of n_e , in this paper, we report the effects of Ar addition on plasma parameters and negative ion production in ECR plasmas.

ECR negative ion source chamber (210mm in diameter 300mm in length) made of stainless steel is a conventional multicusp volume source equipped with both magnetic filter and plasma grid. Plasma parameters were measured by using Langmuir probe movable in axial direction. Faraday cup with deflection magnet was used for measurement of extracted H^- current. For several values of H_2 base pressure, Ar is added and its pressure is increased up to about 50% of the initial H_2 pressure.

By adding Ar, n_e is increased more efficiently than n_e in pure H_2 discharge case. At the same time, T_e hardly changes. Although plasma condition (n_e , T_e) is changed to be suitable for H^- production, H^- current is decreased. By the way, there is a close relation between H^- production and the vibrationally excited hydrogen molecules $H_2(v'')$ [3]. From the viewpoint of producing $H_2(v'')$, the influence of addition of Ar for H^- production has been studied with VUV emission [4]. Then, details of effects of Ar addition for ECR Plasmas are now under study.

References:

- [1] O.Fukumasa, M.Matsumori: Jpn.J.Appl.Phys. 71 (2000) 935.
- [2] K.Tao, K.Fujioka, and O.Fukumasa: 25th ICPIG.4 (2001)167
- [3] O.Fukumasa et al.: Rev.Sci.Instrum. 69 (1998) 995.
- [4] M.Bacal et al.: Rev.Sci.Instrum. 73 (2002) 903.

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