論文 / 著書情報
Article / Book Information

論題(和文)	
Title(English)	A study on effect of cusp magnetic field in a cylindrical IECF device
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出典(和文)	, , ,
Citation(English)	17th US-Japan Workshop on Fusion Neutron Sources for Nuclear Assay and Applications (IEC2015) Book of Abstract, , ,
発行日 / Pub. date	2015, 10

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A study on effect of cusp magnetic field in a cylindrical IECF device

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The development of a compact neutron source, with low radiation hazard, attracts interest in many applications nowadays. IEC device is a fusion device that is capable to be used as a neutron source by D+D→T+p or ^{3}He+n fusion reaction. IEC device has its strong point as a small portable fusion device with low cost operation and maintenance. However, it is difficult to obtain a high neutron production rate (NPR) compared to NPR from fission reactors. A study to find any feasible method in order to increase NPR is one of many challenges for IEC researchers.

One of current studies to increase NPR in Tokyo Tech IEC group is to apply cusp magnetic fields to a cylindrical IEC device. In this study, we use cusp magnetic fields to trap electrons in order to increase D^+ by electron collisional ionization. The increment of fusion fuel ion, D^+, should also increase NPR. In DC glow discharge mode of Tokyo Tech IECF device, NPR is on the order of 10^3-10^5 n/s under discharge condition of -20 ~ -40 kV, 5~15 mA at working pressure of a few Pa. By applying cusp magnetic fields, trapped electrons are expected to ionize neutral gas and increase ion density. Moreover with the presence of magnetic fields, we can operate the system at lower pressure than usual. The benefit of lower pressure operation is to reduce a possibility of losing high energy ions by charge exchange reaction which reduces overall NPR.

At the cathode voltage, current and pressure of -40 kV, 5 mA and 2 Pa, we got NPR of about $6x10^3$ n/s in normal operation while NPR obtained when cusp magnetic fields exist was about 2 times higher ,$12x10^3$ n/s, as shown in Fig.1.

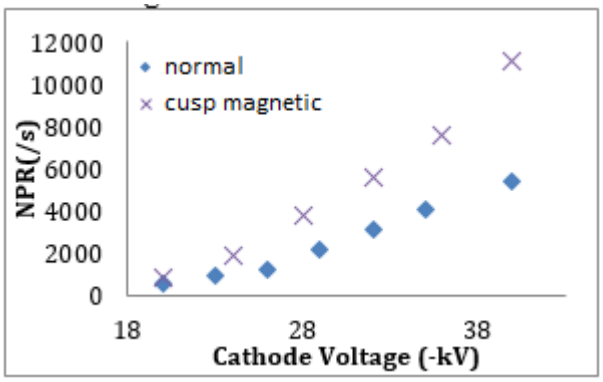

Fig.1 NPR vs cathode voltage (at cathode current of 5 mA)

Even though the overall NPR is still low but cusp magnetic fields show a feasibility to increase NPR. A further study of its effect in case of high power operation is needed to be investigated in the future experiments.