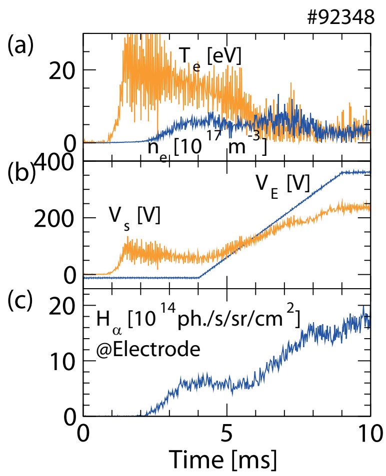
Electrode positive biasing experiment for ion acceleration study

A. Okamoto, K. Shimizu, T. Oku, Y. Sato, S. Kitajima

Department of Quantum Science and Energy Engineering, Tohoku University, 6-6-01-2 Aobayama, Sendai 980-8579, Japan

e-mail atsushi.okamoto@qse.tohoku.ac.jp

Compatibility between high beta plasma sustainment and alpha particles confinement is important for a nuclear fusion reactor. Utilizing small devices those have various magnetic configurations is an effective way especially for exploring a better configuration of a stellarator reactor. Energetic ion injection method is, therefore, required as producing virtual alpha particles in small devices. While a neutral beam injection system equipped around a torus device supplies solutions, the birth point of the energetic ions are restricted due to the fixed beam line and the ionization depending on the target plasma. A compact ion injector inside the last closed flux surface is expected to give more flexible experiments.
We have started development of an *in-situ* energetic ion injector using a hydrogen storage electrode[1]. Positive potential was applied to the electrode in a stellarator device, Tohoku University Heliac. In this presentation, possibility of proton acceleration is discussed in terms of plasma responses to time varying biasing voltage.
Target was helium plasma produced by an alternating current ohmic heating. Typical waveform is shown in Fig. 1. Space potential V_s is compared with the electrode biasing voltage V_E. When the biasing voltage increases ($V_E = 350$V), the space potential increases up to $V_s \simeq 250$V. Maximum potential difference $V_E - V_s \simeq 150$V is generated at the outermost flux surface of the electrode locating.
Line emission intensities of hydrogen atom (H_α) were measured on a electrode-viewing chord and a background chord. H_αs were increased when the biasing voltage was higher than the space potential, $V_E > V_s$. The ratio of H_α on the electrode to that of the background also increased in the same time, suggesting hydrogen ejection from the electrode.



Time evolution of typical discharge. (a) electron density and temperature, (b) electrode and space potentials, (c) hydrogen emission intensity at the electrode.

The work was partly supported by JSPS KAKENHI Grant Number 24246152.

[1] A. Okamoto, *et al.*, Rev. Sci. Instrum. **85** (2014) 02B302