Abstract for an Invited Paper
for the DPP08 Meeting of
The American Physical Society

Development of High-Density Helicon Plasma Source and Its Applications[1]

SHUNJIRO SHINOHARA, Kyushu Univ., Japan

High-density helicon plasmas can serve for various applications, including electric propulsion and basic research. Recently, we have developed new sources: the very large, 75-cm-diam and 486-cm-long [1, 2], and the very small, 2.5-cm-diam and 4.7-cm-long [3] ones. We discuss characteristics of these sources, new plasma acceleration schemes, and some underlying physics. The large source uses a multi-turn planar antenna located behind the end-window, i.e., an excitation scheme not widely used and, thus, not well comprehended. With the length reduced down to 81 cm, this source has shown a unique capability to support the discharge with only 1-W input power and to provide in the high-density mode an excellent production efficiency, $\sim 10^{14}$ electrons/W. Profiles of plasma density and wave field depend on the magnetic field and antenna configurations. In particular, we have found the excitation of higher (more than the second order) radial wave modes that do not occur normally in standard helicon sources. Successful high-density plasma production with axial length less than 15 cm was also executed. In the small helicon source, we examined new plasma acceleration schemes with application of the rotating or sawtooth-shaped electric fields with the divergent magnetic field. These methods were found to result in increase of the exhaust velocity up to several km/s and, thus, to have potentiality for electric propulsion. [1] S. Shinohara and T. Tanikawa, Rev. Sci. Instrum. **75**, 1941 (2004) & Phys. Plasmas **12**, 044502 (2005), [2] T. Tanikawa and S. Shinohara, Thin Solid Films **506-507**, 559 (2006), [3] T. Toki *et al.*, IEPC 03-1168, the 28th Int. Electric Propulsion Conf., 2003 & Thin Solid Films **506-507**, 597 (2006).

[1]In collaboration with T. Tanikawa, K. Toki, K. P. Shamrai, T. Hada, T. Motomura, K. Tanaka, and Y. Tanaka. Work partly supported by JSPS, Japan.