7th Asia-Pacific Conference on Plasma Physics, 12-17 Nov, 2023 at Port Messe Nagoya

Research Activities at the Magnetised Plasma Interaction Experimental Facility

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High density hydrogen plasma sources in the presence of a magnetic field are of importance to several areas such as material processing, studying fusion-relevant plasma-surface interactions, developing neutral beam injection systems, and plasma propulsion. Helicon coupled plasmas have been proposed as a possible design alternative to current ICP systems as a negative source for neutral beam injection systems due to lower RF power. Helicon plasmas can obtain higher plasma densities by an order of magnitude and achieve higher n_H /n_{H2} ratios compared to ICP systems for the same RF power; are able to generate stable plasmas at lower pressures; and do not require extensive re-design of current source designs. Most studies on helicon-based plasmas have focused on lower power operation of less than 2 kW.

The MAGnetised Plasma Interaction Experiment (MAGPIE) at the Australian National University (ANU) is a high-power helicon plasma device operating at RF powers up to 20 kW. The magnetic field configuration of MAGPIE is versatile and can provide both magnetic mirror and diverging field configurations. To date, many of the studies on MAGPIE have been carried out with the magnetic mirror configuration. High plasma densities of a few 10^{19} m^{-3} have been achieved with relatively low electron temperatures (< 8eV) at low pressures (<10 mTorr). An example of spatially resolved electron densities and temperature in MAGPIE is shown in Figure 1 when operating with a magnetic mirror.

This contribution will combine several studies on gas heating, plasma chemistry, negative ion dynamics and neutral depletion [1-8]. The plasma is diagnosed using probe-based laser photodetachment, Langmuir probes, laser induced fluorescence, cavity ringdown spectroscopy, mass spectroscopy and optical emission spectroscopy. The experimental results are compared and validated with both a zero-dimensional global model and a 2D axisymmetric model. This presentation will provide an overview of research conducted at the MAGPIE facility on negative ion production, plasma-material interaction studies and plasma torches.

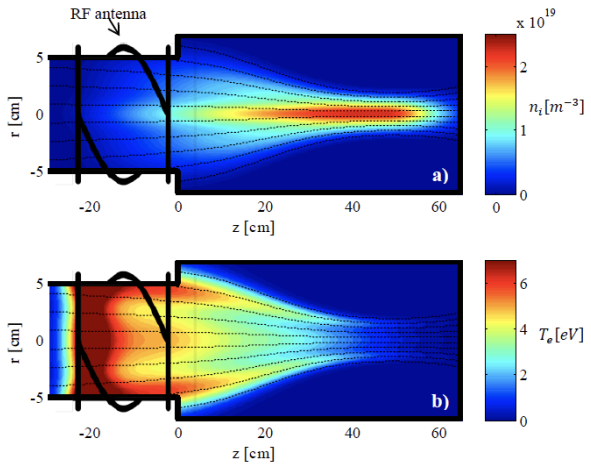

Figure 1. Spatially resolved electron density and temperature in a hydrogen plasma operating at 10mTorr, 20 kW with a magnetic mirror.

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