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R&D of linear plasma facilities for PMI research at ASIPP

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Linear plasma devices can produce low energy, high flux plasmas to simulate boundary conditions in tokamaks. Recently, two new linear plasma facilities have been built at the Institute of Plasma Physics, Chinese Academy of Sciences (ASIPP). To understand the hydrogen isotopes behavior in first wall materials, the PREFACE (Permeation and Retention Evaluation FACility for fusion Experiments) machine has been constructed. Another effort is to achieve reactor-relevant divertor plasma parameters in laboratory using RF-based technology. For this purpose, the HPPX (Helicon Physics Prototype eXperiment) machine has been built to address some scientific and technical issues of steady-state helicon plasma discharge.
The main mission of PREFACE is to perform hydrogen plasma-driven permeation (PDP) experiments on plasma facing materials. The PREFACE facility is equipped with a 6 kW@2.45 GHz electron cyclotron resonance (ECR) source and plasmas with a diameter of 40 mm can be produced. The typical electron temperature and density are Te = 2-6 eV and ne = 1E16-1E17 m-3, respectively. For PDP experiments, the plasma density should not be too high to avoid the melting of sample membrane. The basic diagnostics includes a Hiden Langmuir probe, an Avantes spectrometer (197-717 nm) and several thermal couples. Hydrogen isotopes permeation and retention data have been taken for materials like tungsten, reduced activation martensitic/ferritic steels and copper alloys in PREFACE.
The HPPX facility has a 4 m long vacuum chamber, which consists of four 1 m sectors with an inner diameter of 0.5 m. Modularization design has been applied so that the vacuum vessel can be easily extended for other research purposes in the future. At present, a 13.56/27.12 MHz RF source has been connected to the machine and the maximum power is 50 kW. A steady-state plasma density of >1E19 m-3 is expected. The electron temperature and density will be further increased by extra plasma heating. An ECR source with a power of over 100 kW has already been proposed.

Eligible for student paper award?

No

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