Operation of the ORNL High Particle Flux Helicon Plasma Source*

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A high power, high particle flux rf-based helicon plasma source has been constructed at ORNL and operated at power levels up to 30 kW. High-density hydrogen and helium plasmas have been produced. The source has been designed as the basis for a linear plasma materials interaction (PMI) test facility that will generate particle fluxes $\Gamma_p > 10^{23}$ m^{-3} s^{-1}, and utilize additional ion and electron cyclotron heating to produce high parallel (to the magnetic field) heat fluxes of ~ 10 MW/m^2. An rf-based source for PMI research is of interest because high plasma densities are generated with no internal electrodes, allowing true steady state operation with minimal impurity generation. The ORNL helicon source has a diameter of 15 cm and to-date has operated at a frequency f = 13.56 MHz, with magnetic field strength |B| in the antenna region up to ~ 0.15 T. Maximum densities of 3×10^{19} m^{-3} in He and 6×10^{18} m^{-3} in H have been achieved. Radial density profiles made during helium operation have shown strong central peaking, as is commonly seen in helicon discharges. Profiles measured during hydrogen operation have been significantly broader. Plasma loading of ~ 4 Ω has been measured during high-density operation with hydrogen. The latest results will be presented.

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