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Design, development and recent experiments at the CIMPLE-PSI device

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It is important to understand how the plasma with unparalleled heat (˜10MWm-2) and ion (˜1024 m-2s-1) flux will interact with the tungsten walls in the ITER tokamak, more specifically at the Divertor region of the fusion machine. Several linear magnetized plasma devices have been developed worldwide that reproduced ITER Divertor like extreme conditions for studies on relevant plasma surface interaction (PSI) issues under simulated plasma conditions. The "CPP-IPR Magnetized linear Divertor Plasma Experiment for Plasma Surface Interaction"or CIMPLE-PSI is one of the few Tokamak Divertor simulator devices that successfully reproduces both ITER-like ion and heat flux values, whose design, development and recent commissioning will be presented in this paper. A segmented plasma torch produced high-density plasma jet collimated with a maximum 0.45 Tesla axial magnetic field propagates at few Pascal chamber pressure that is maintained by four numbers of roots vacuum pumps with 14,000 m-3/h pumping capacity that interacts with a remotely placed tungsten target under controlled experimental conditions. The paper will report detailed diagnostics of the plasma jet through optical emission spectroscopic techniques (1.33 m McPherson spectrometer), a retractable Langmuir probe and water calorimeters while operating the plasma with helium and hydrogen mixture of gases. During recent PSI experiments in this device under irradiation of pure helium plasma (exposed for 1800 seconds under 0.3T magnetic field, target biased to -45 V), we had witnessed (FESEM, HRTEM) formation of surface nanotendrils in profuse amounts, recent characterization results from which also will be presented here.

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