(SG1, MAP) Session Report

May 22, 2024 (M. Shoji)

Date: May 21, 2024
Time: 9:42 – 16:43
Shot#: 191511 – 191631 (121 shots)
Prior wall conditioning: He GDC
Divertor pump: Off
Gas puff: He, H_2
Pellet: TESPEL

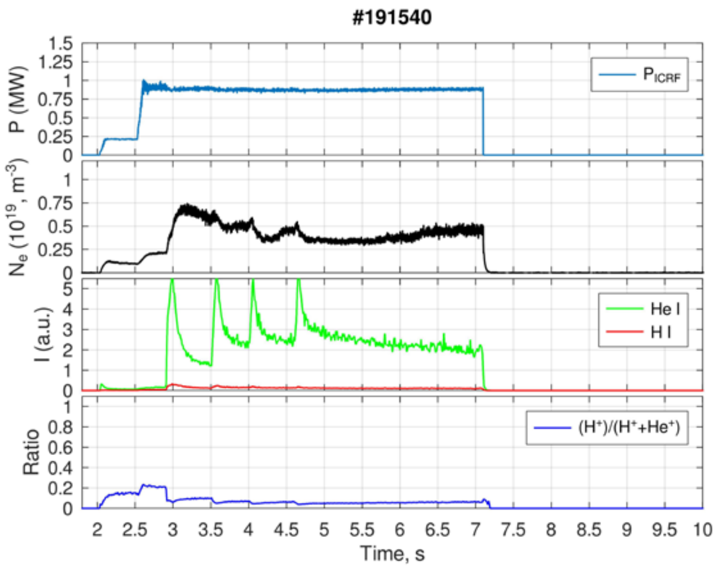
NBI#(1, 2, 3, 4, 5) = gas(H, H, H, H, H)=P(4.5, 4.4, 4.3, 3.7, 3.4) MW
ECH(77GHz) = ant(1.5-Uo, 5.5-U, 2-OUR)=P(-, 0.69, 0.38) MW
ECH(154GHz) = ant(2-OLL, 2-OUL, 2-OLR)=P(0.71, 0.89, 0.98) MW
ICH(3.5U, 3.5L, 4.5U, 4.5L) = P(?, ?, ?, ?) MW

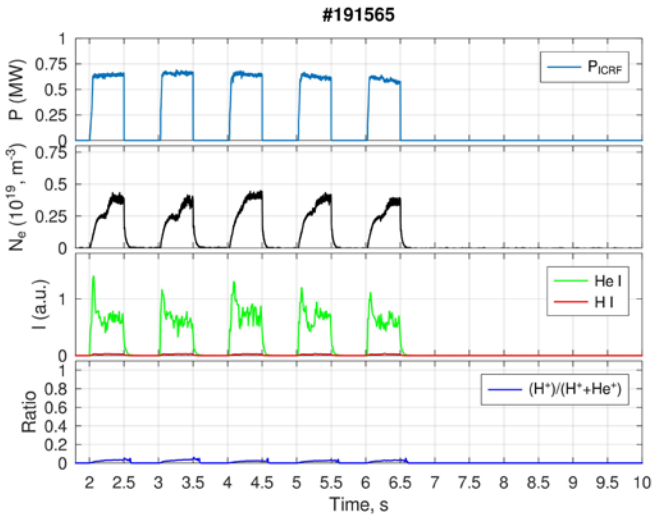
Topics

1. RF plasma production at relatively low magnetic fields for wall conditioning（Y. Kovtun(KIPT), T. Seki）
2. Micro-trench measurement of incident ion angles and boron deposition at the divertor surface (S. Abe(PPPL), S. Masuzaki)
3. Mitigation of tungsten-induced plasma termination and identification of transient transport mechanisms (H. Bouvain(IPP), N. Tamura)

RF plasma production at relatively low magnetic fields for wall conditioning
(Y. Kovtun, T. Seki, V. Moiseyenko)

Experimental conditions: (R_{ax}, Polarity, B_t, **γ**, **B_q**) = (3.6 m, CW, 0.4 T, 1.254, 100.0%) Shots: #191515 - #191565





Goal of this experiment:
- To study the plasma production with only ICRF heating (higher harmonic cyclotron resonance conditions) on the low magnetic field configuration in He plasmas for wall conditioning

Results:
- Different scenarios of ICRF plasma production under constant gas flow and additional gas injection have been make out.
- In all scenarios, stable RF breakdown and plasma creation are observed.
- The plasma density is observed to be 6e18 m^{-3} at an injected power of 0.9 MW.
- The achieved densities were proportional to the injection power of ICRF.

Checking the neutral pressure and these contents using QMS

Micro-trench measurement of incident ion angles and boron deposition at the divertor surface

S. Abe (PPPL), S. Masuzaki

Shot #: 191566 – 191586 (sample exposure: 191582-191586)

(R_{ax}, B_t, γ, B_q) = (3.6 m, 2.75 T, 1.2538, 100.0%)

Working gas: He

P_{ECH} ~3 MW, $P_{t\text{-}NBI}$ ~ 12 MW, $P_{p\text{-}NBI}$ ~ 6MW (modulated)

Objectives

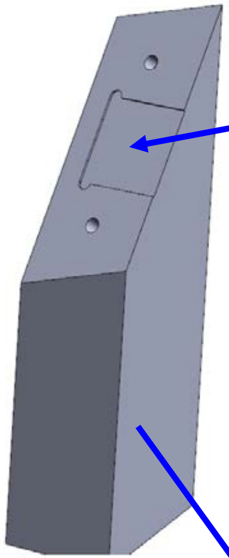
- Measurements on the incident ion angle (IIA) for both polar and azimuthal directions of H and He ions at ITER-relevant magnetic-field incident angle, α ~ 86° (referenced to the surface normal).
- Measurements on boron gross deposition transported from the impurity powder dropper (IPD).

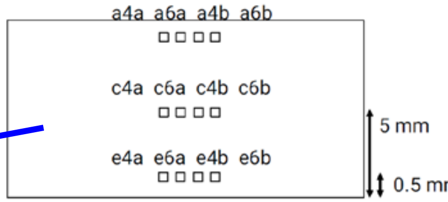
Method

- The sample holder designed to have the Si crystal surface and Al-coated Si crystal surface at α ~ 86° is installed in LHD using the 4.5L manipulator. We expose two micro-trench fabricated Si crystals for each H and He shots.
- Surface analysis using SEM-EDS.

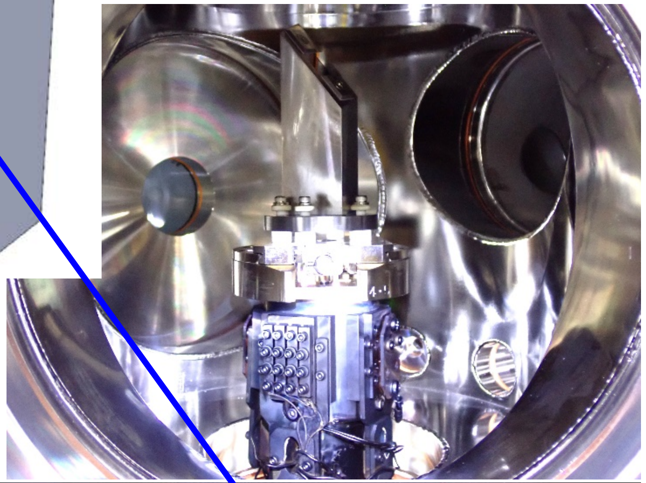
Results

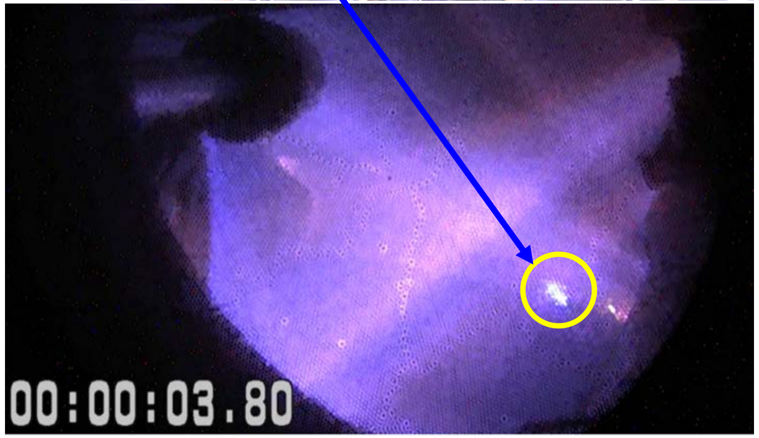
- Samples were exposed to He dominant plasmas with He/(He+H+D)>85%.
- Surface analysis of the samples will be conducted after retrieving them from the manipulator.





Positions of micro-trench (35μmx35μmx4or6μm) on Si / Al coated Si sample





Mitigation of tungsten induced plasma termination and identification of transient transport mechanisms (N. Tamura, H. Bouvain, A. Dinklage et al.)

Magnetic configuration: (R_{ax}, Polarity, B_t, γ, B_q) = (3.60 m, CW, 2.750 T, 1.2538, 100.0%)
Shots: #191598 - #191631

Goal of this experiment

- Investigate difference in electron and ion heating as rescue mechanism for tungsten TESPEL induced plasma termination.
- Investigate dependency of termination mitigation on ECRH deposition position

Background & Motivation

- On-axis ECRH in H-plasma mitigates plasma termination induced by tungsten TESPEL
- It is presumed that off-axis ECRH as mitigation measure changes the time scales of the thermal quench
- It is presumed that pure ion heating changes the dynamics of the thermal quench

Approach & Methodology

- Injection of 3e17 W tungsten TESPEL into ECRH-heated He/H plasmas:
  - ✓ Scan of delay time of additional ~1MW ECRH at $\rho = 0.3$ with delay times $\Delta t = [5,10,15,20,40,80,150,200]$ ms
  - ✓ Scan of delay time of additional ~1MW ECRH at $\rho = 0.5$ with delay times $\Delta t = [5,10,15,20,40,80,150,200]$ ms
  - × Scan of delay time of additional ICRH → trigger failed

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Results

- 28 3e17 W TESPEL injected (89% successful delivery)
- Additional ECRH prevents He/H plasma termination induced by tungsten TESPEL
- Optimal delay time for off-axis ECRH ($\rho = 0.3$): $\Delta t = 15$ms
- Additional ECRH closer to on-axis deposition shows stronger mitigation effect