(TG3) Spectroscopy Topical Group Report

Dec. 21, 2021 (M. Yoshinuma)

Date: Dec. 17, 2021
Time: 11:30- 15:40
Shot#: 175415 – 175489 (75 shots)

Prior wall conditioning: D2 glow discharge
Divertor pump: ON (w/o 2I)
Gas puff: H, D, Ne, N
Pellet: -

NBI#(1, 2, 3, 4, 5)=gas(H, H, H, D, D)=P(3.9, 3.5, 3.6, 4.6, 5)MW

ECH(77GHz)=ant(5.5-Uout (and 1.5U), 2-OUR)=P(703, 792)kW
ECH(154GHz)=ant(2-OLL, 2-OUL , 2-OLR)=P(723, 799, 825)kW
ECH(56GHz)=ant(1.5U)=P(-)kW
ICH(3.5U, 3.5L, 4.5U, 4.5L)=P(-)MW
Neutron yield integrated over the experiment = 1.7×10^{15}

Topics

1. Deuterium retention in damaged tungsten (M.Zhao, S.Masuzaki)
2. Evaluation Zeff in LHD (Y.Kawamoto, T.Oishi)
3. Diagnostics of relativistic electrons by Thomson scattering in high electron temperature plasmas (H.Funaba)

Deuterium retention in damaged tungsten (2021/12/17 experiment)

Motivation: Distribution of hydrogen isotope retention in tungsten at LHD divertor strike line.

- **Material**: Mirror finish ITER grade W tiles (28×6×1).
- **Iron (Fe) ion irradiation**, with peak damage 1dpa, was performed to simulate neutron irradiation defects.

LHD experiment

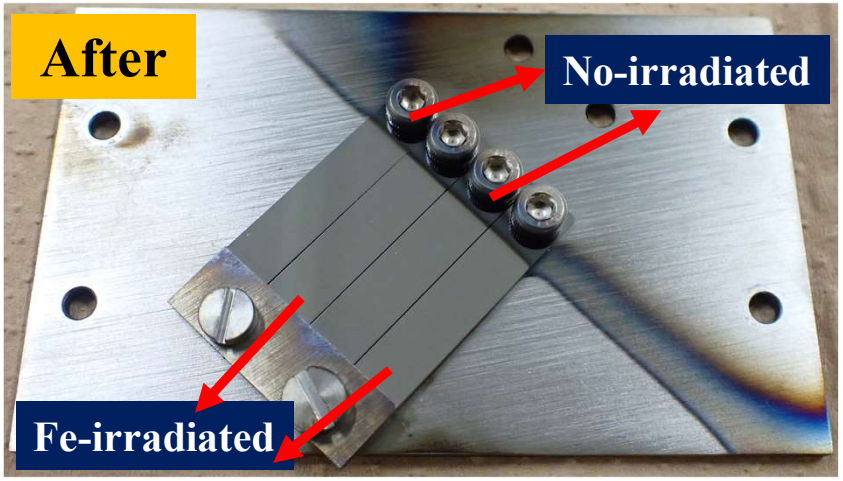
- Experiment time:2021/12/17.
- Shot number:175416-175426.
- NBI-1, NIB-2, NBI-3: ~3.6 MW
- B=2.750T, Rax=3.6 m.

Preliminary results:

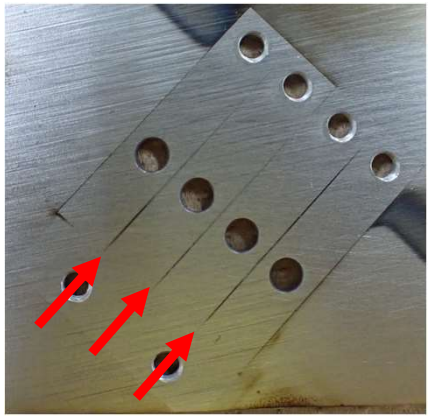
- No visible damage on W surface.
- Deposition can be observed at private region and gaps between W titles.
- Weight difference show that deposition dominant for all four samples.

Next plan:

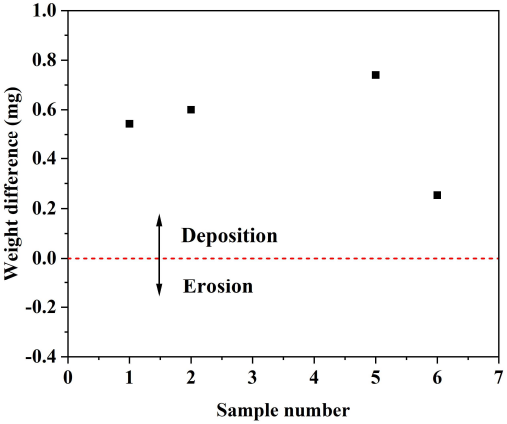
- D/He mixture plasma exposure will be performed to study He effect.
- Hydrogen isotopes retention, deposition and microstructure modification will be studied by IP, NRA, RBS, SEM, TEM, TDS



Deposition on Mo holder at gap regions



Weight difference before and after plasma exposure.



Evaluation of Z_{eff} in LHD (Y.Kawamoto)

2021/12/17

Experimental conditions:(R_{ax}, Polarity, B_t, γ, B_q) = (3.6 m, CW, 2.75T, 1.254, 100.0%)(# 175428 - #175468)

[What I research]

Motivation: I'd like to confirm from experiments how much Ne or N penetrate the plasma.

This experiment:

I evaluated <Z_{eff}> when Ne or N_2 is puffed.

[What I did]

EGdata named zeff_mk300 is used for <Z_{eff}>

[What I found]

I confirmed that <Z_{eff}> increased when Ne was puffed (Fig.1).

The following data, that backs the result above, were obtained.

- NB has not strong influence (Fig.2).
- Gas puff feedback has no influence (because Fig.1 and Fig.2 has less difference).

[What I do next]

- Analysis of N case.
- Convert the evaluated <Z_{eff}> to the actual amount of plasma penetration.

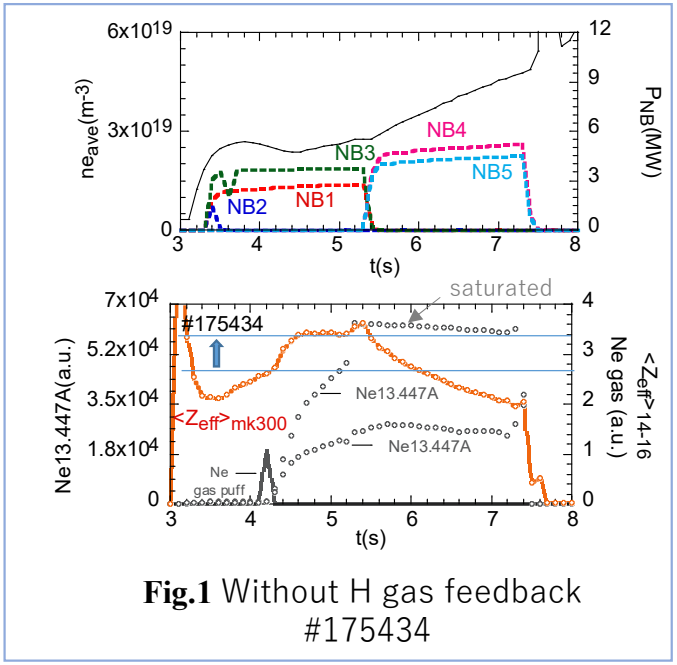


Fig.1 Without H gas feedback #175434

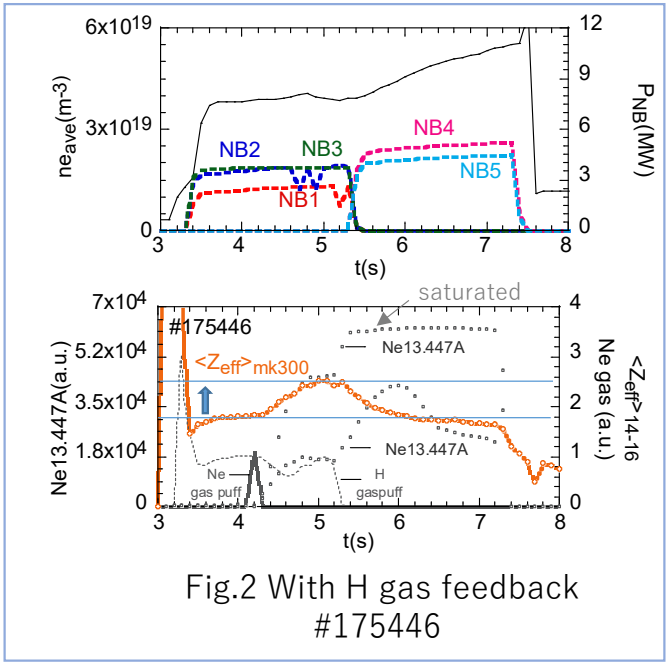


Fig.2 With H gas feedback #175446

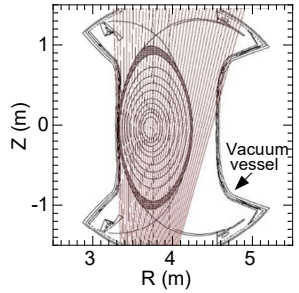


Fig.3 sightline (7.5-L)

Diagnostics of relativistic electrons by Thomson scattering in high electron temperature plasmas

Experimental conditions:

1. (R_{ax}^{VAC}, Polarity, B_t, g, B_q) = (3.55 m, CW, 2.789 T, 1.254, 100.0%)
   (# 175470 - #175489) ECH power: 3.84MW, NBI#1,2,3 (t = 4.8-6.8s) : 11.3MW
   Thomson scattering : In forward configuration, measurement of $Te_{//}$

Purposes and Improvements:

(0) The optocs for the $Te_{//}$ measurement was installed in 12 November.

(1) In order to observe the forward scattering signals at the center, the optical fiber for R=3.55m is connected to Poly#143 which has the filters for the low-Te combination in the backward scattering configuration.

(2) The measurement of $Te_{//}$ at R = 3.62m is made by Poly#144.

Results:

Te(0) of 15 - 20 keV was expected in low electron density region of $5x10^{18}m^{-3}$ (#175471). However, the signals of Poly#143 were small. In #175488 where the plasma is almost same as #175487 (Te(0) ～ 10keV, ne ～ $1.2x10^{19}m^{-3}$), signals of Chs. 3 - 5 in the forward scattering configuration were observed at Poly#143 and 144.

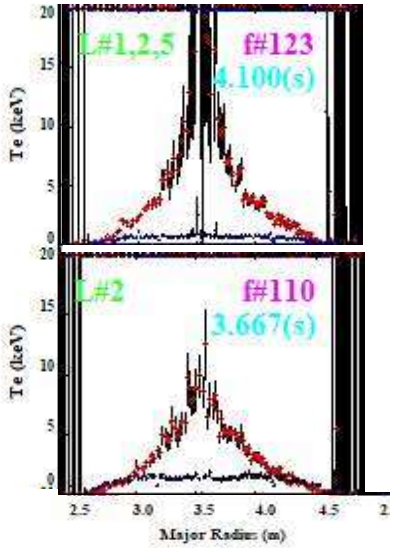


Fig. 1. Te profiles of #175471(top) and #175487(bottom).

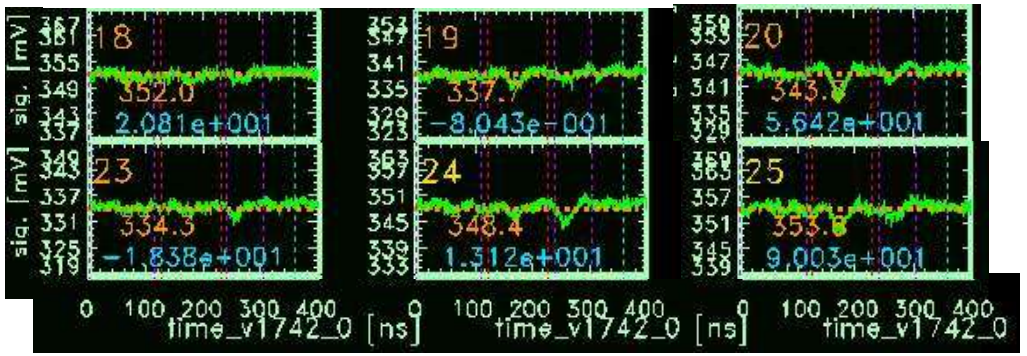


Fig. 2. Signals of ch. 3, 4 and 5 of Poly#143 (R = 3.55m, top) and #144 (for $Te_{//}$ measurement, bottom) in #175488.