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Surface deterioration and recovery of CXRS first mirror in EAST

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First mirror (FM) is the key element of the optical and laser diagnostic systems in fusion devices such as ITER. Facing the plasma directly, it has to operate in an extremely harsh environment and suffer from the sputtering by high energy ions and charge exchange atoms, the impurity deposition due to wall conditioning and the sputtered wall materials etc [1,2], which results in the deterioration of the reflectivity and shorter lifetime. Protective shutter and plasma cleaning are widely studied to mitigate the deposition during the FM operating and remove the impurities deposits afterwards in recent years [3,4] .
The non-plane large size (300 mm×80 mm×40 mm) FM, made of 316L SS was used for the charge exchange recombination system (CXRS), which has been operated in EAST for 361 days in three experimental campaigns from 2014 to 2016. The FM was exposed to the plasma with a total discharge pulse of 12499 shots and a total duration time of 86036 s. During the exposure, a capsule holder and a motor shutter were used to mitigate the deposition. The scanning electron microscopy (SEM), electron energy disperses spectroscopy (EDS), laser beam injection spectrum and a self-made laser system were used to characterize the surface morphology, impurity composition and the reflectivity of the CXRS FM. The inhomogeneous deposition consisting of C, O, Si, W and Mo was detected on the FM surface due to the shadow of the holder on FM surface and the gap between the shutter and the holder. The sizes of the particles were about several micrometers to tens of micrometers. Due to the severe deposition, the reflectivity of the FM was strongly decreased from 71% to 15% at the wavelength of 532 nm. To recover the FM surface and address the cleaning effectiveness and homogeneous of the non-plane large size mirror as well as find a possible way for FM in-situ cleaning in EAST in the future, the Ar plasma driven by the 13.56 MHz RF capacitively coupled system was used to clean the FM. After 187.3 h cleaning, the inhomogeneous deposition was visibly unseen and uniformly removed. The SEM and EDS results indicated that the micro morphology was developed during the cleaning and few residual particles consisting of C and O were also remained and covered about 5.3% of the cleaned mirror surface. The reflectivity of the FM surface was recovered to 68% which demonstrated the cleaning effectiveness and homogeneous of the RF plasma cleaning the non-plane large mirror. To prolong the FM lifetime, the optimization of the capsule holder and motor shutter was suggested and the regular in-situ cleaning was proposed.

[1] V. S. Voitsenya, A. E. Costley, V. Bandourko, et al.Rev. Sci. Instrum. 72, 475 (2001).
[2] A. Litnovsky, P. Wienhold, V. Philipps, et al. J. Nucl. Mater. 363–365, 1395 (2007).
[3] Ivanova D, Rubel M, Widdowson A, et al. Phys. Scr. T159 14011 (2014).
[4] Lucas Moser, Roland Steiner, Frank Leipold, et al. J. Nucl. Mater. 463 , (2015) 940 - 943.

Eligible for student paper award?

No

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