ENDOSCOPE LASER-INDUCED BREAKDOWN SPECTROSCOPY (LIBS) FOR *IN SITU* ELEMENTAL DISTRIBUTION DIAGNOSIS ON THE SURFACE OF DIVERTOR IN EAST

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The online elemental analysis of plasma-facing components (PFCs) is crucial for magnetic confinement nuclear fusion deceives, such as tokamak and stellarator. Elemental distribution directly reflects the conditions of PFCs and processes of plasma-wall interaction (PWI). The laser-induced breakdown spectroscopy (LIBS) diagnostic technology provides a promising method for wall composition monitoring for nuclear fusion deceives. In recent years, we have developed LIBS to characterize the co-deposition of impurities, fuel retention and wall conditioning on the first wall in EAST and HL-2A/M tokamaks as well as W7-X stellarator. [1,2] An *in situ* LIBS system in EAST has been built to provide elemental composition on the first wall since 2014. [3] Recently, an *in situ* endoscopic laser-induced breakdown spectroscopy (LIBS) diagnostic system for the full tungsten divertor in EAST has been developed since the 2021 experimental campaign. This system provides online elemental distributions on the divertor with various discharge parameters and wall conditions.

The endoscope optical system is inserted into the EAST vacuum chamber at H port (as shown in fig. 1). At the end of the tube, a vacuum window and a mirror are installed to reflect the laser to the divertor. Meanwhile, the same mirror was used to collect the signal from LIBS plasma. A scanning system is used to rotate the endoscope mirror and scan the laser spot on the surface of the divertor. Because the distance between the divertor surface and the mirror changes during the scanning, an online optical focusing system is installed to ensure that the focus point of the laser is always on the surface of the divertor. In addition, all mechanical parts of the LIBS system are magnetic shielding. The scanning region of LIBS covers W upper divertor (inner target, inner baffle and dome) and part of Mo first wall. The poloidal scanning step of the laser spot can reach 0.4 mm. The repeatability is <0.2 mm. An ns YAG laser and different types of spectrometers with wavelength covers of 400 nm - 780 nm are used.

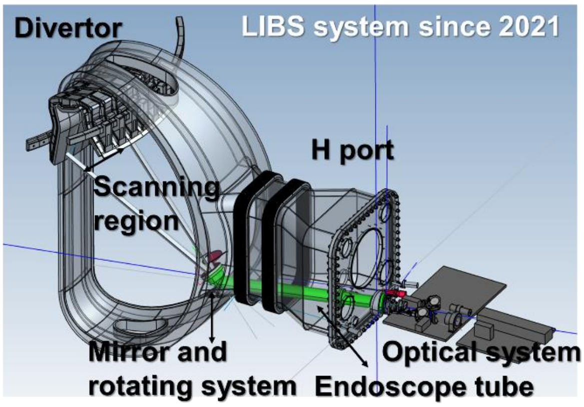

Fig. 1. The schematic of endoscope LIBS system for upper W-divertor in EAST

The results show that the elemental distribution on the W divertor tiles is nonuniform. The H to D ratio (H/(D+H)) can be obtained by the LIBS spectral fitting. Fig. 2 shows the LIBS results about H/(D+H) on the surface of the divertor during the baking and glowing discharge clean. The H/(D+H) decreases from 100% to 17%~24% after the wall conditioning. The intensities of H, D, and O on the surface of the divertor decrease when the wall is clean. In addition, the short-term fuel retention behaviour on the divertor surface of EAST is also studied. The dynamic D content on the W divertor decreases after the plasma exposure due to the dominant short retention with the outgassing process.

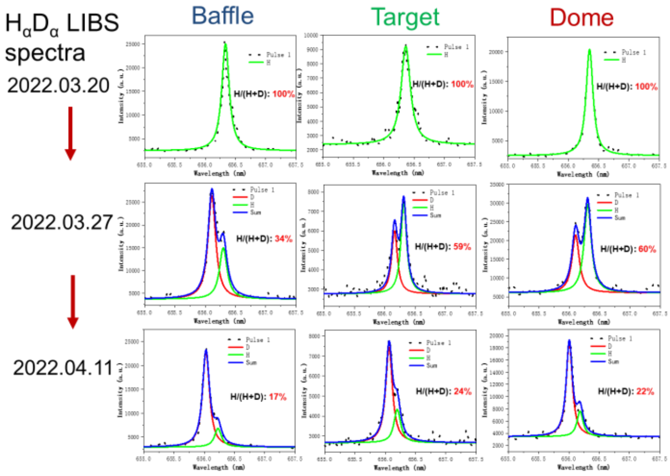

Fig. 2. The LIBS spectra of H_α and D_β on the surface of the divertor after wall conditioning with different poloidal positions

In addition to the poloidal distribution, LIBS can also provide depth distribution by ablating at the same position with successive lasers. Combining the poloidal and depth distributions, the cross-section distributions of B (B II 703.2 nm) and Mo (Mo I 550.6 nm) are shown in fig. 3. It clearly shows that B and Mo deposited on the surface of the divertor but presented different trends. The B is from the wall conditioning of boronization. The Mo is from the erosion of the first wall. In addition, the Li-D co-deposition behaviours are investigated during long-pulsed discharges by LIBS. The D retention and Li deposition rates are higher near the striking points. These works also provide the key technology of wall elemental diagnosis for future fusion devices. Further details will be presented at the conference.

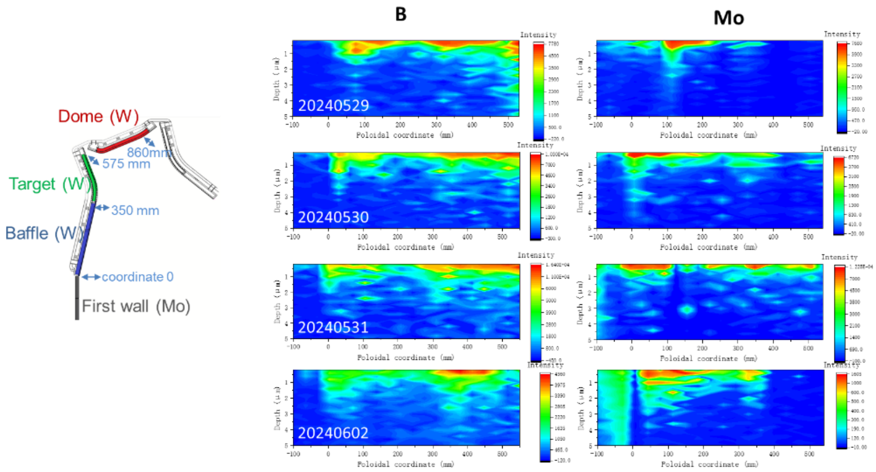

Fig. 3. The cross-section distributions of B and Mo on the upper divertor in EAST

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