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Laser Technology for Resident Tritium In-situ Measurement in CEPT Device

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Due to the fact that during Tokamak operation，Plasma Facing Materials，PFM，are able to trap part of the fuel，particularly Tritium，, these resident fuel have to be measured and removed. LIBS，Laser induced breakdown spectroscopy， and LIDS ，Laser induced desorption spectrometry，are two of the most promising techniques to solve these issues which allow to achieve an on-line and ultra-sensitive measurement of the fuel retention in vessel.
In this work, LIBS and LIDS were integrated on to a Tritium penetrating and resident assessing instrument named CEPT，Comprehensive ECR Plasma for Tritium， for in-situ tritium retention analysis. An Nd:YAG laser, operating at 1064 nm, with pulse duration of 4-7 ns was used to interact with PFM simulant sample. The spectra emitted from plasma plumes was recorded by the Aryelle 200 spectrometer(，/，，=12500) in the spectral range between 265 nm and 665 nm with an Andor iStar 334 ICCD camera. The mass spectra of particles escaped from the sample due to the laser radiation were obtained using a quadrupole mass analyser (QMA) at range of 1-100 amu.
A verification experiment was carried out at a pressure range from 1 bar to ultra-high vacuum(10-5 Pa) in He and air for LIBS and range from 10-2-10-5 Pa for LIDS. The LIBS results show that the atomic spectral lines of H, D, W was achieved when a delay time of 0.3 us was installed, in the meanwhile, the released hydrogen isotopes were monitored by the QMA. This technique achieves good spatial resolution without any sample preparation. For comparison, the samples were also analysed by other conventional methods.

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