27th IEEE Symposium on Fusion Engineering

Contribution ID: **352**

Type: **Oral**

# Extreme ultraviolet spectroscopy applied to study RMP effects on core impurity concentration in EAST

*Thursday 8 June 2017 16:20 (20 minutes)*

Impurity control is one of the key issues to improve confinement performance in present fusion research. The application of resonant magnetic perturbations (RMP) has been proposed as a candidate method to reduce impurity concentration in the core region of magnetically-confined plasmas. In order to understand the effects of RMP on impurity transport, a space-resolved extreme ultraviolet (EUV) spectrometer is used to observe the spatial distribution and temporal behavior of core impurity emissions at the Experimental Advanced Superconducting Tokamak (EAST). The space-resolved EUV spectrometer consists of a 30 $\mu m$-width entrance slit, a 1 $mm$-width spatial resolution slit placed in front of the entrance slit, a concave varied line-spacing (VLS) grating and a back-illuminated charge-coupled device (CCD) detector. Impurity emissions passing through the spatial resolution slit and entrance slit are refracted on the gold-coated holographic grating (1200 grooves/$mm$) at an incident angle of 87°, resulting in a wavelength resolution of 0.06 Å and 0.15 Å at wavelengths 35 Å and 200 Å, respectively. The spectra in the wavelength range of 30 $\leq \lambda \leq$ 500 Å are then recorded by the CCD (2048×2048 pixels with a pixel size of 13.5×13.5 $\mu m^2$) installed behind the grating. The vertical profile of impurity emissions in the range of 0 $\leq Z \leq$ 450 $mm$ is projected on the CCD using the narrow spatial-resolution slit placed horizontally in the spectrometer. In the present study, line emissions of carbon and iron are observed for C VI (33.7 Å, $2p$–$1s$) and Fe XXIII (132.9 Å, $1s^2 2s2p$–$1s^2 2s^2$), respectively, whereas the unresolved transition array (UTA) of tungsten in the wavelength range of $\lambda$ = 30–70 Å is monitored to study tungsten behavior when RMP are applied. It is clearly observed that the intensities of C VI, Fe XXIII and W-UTA emissions are reduced by the application of either static or rotating RMP fields, particularly during stages of edge localized modes (ELMs) mitigation in $\sim$20 $s$ long pulse discharges. In addition, the reduction in iron and tungsten emissions with $n$=1 and 2 ($n$: toroidal mode number) RMP is more significant than that of carbon emissions, i.e., $\sim$50–70% for W-UTA and Fe XXIII, while $\sim$40% for CVI. Considering that the line-averaged electron density $n_e$ only decreases $\sim$20% in the same discharges, the EUV spectrometer measurements indicate that RMP can significantly decrease the impurity concentration in the core region on top of overall particle pump out. The spatial distributions of impurity emissions are also measured for different impurity species using the EUV spectrometer in EAST. The results confirm the feasibility of the space-resolved EUV spectrometer to study the effects of RMP on the core impurity concentration based on the measurement of time evolution and spatial distribution of impurity emissions.

## Eligible for student paper award?

Yes

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**Session Classification:** R.OP5: Experimental Devices II

**Track Classification:** Diagnostics and instrumentation