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Study on core impurity transport in RMP ELM-mitigated plasmas at EAST

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Efficient and safe operation of fusion devices requires monitoring and control of impurities responsible for some of the most dramatic fuel dilution and radiative power losses from the plasma. An impurity transport study addressing mitigation and control regimes based on experimental results at EAST has thus been undertaken. It has been demonstrated by various experiments that resonant magnetic perturbation (RMP) is an effective and promise method to mitigate or suppress edge localized mode (ELM) [1]. RMP has also been successfully applied at EAST to completely suppress ELMs [2]. It is also clearly observed that impurity emissions in the core region significantly decrease during the RMP ELM-mitigation phase at EAST. Therefore, core impurity transport is studied in RMP ELM-mitigated plasmas to understand the physical mechanism through which RMPs effect the transport of impurities. Accordingly, a flat-field space-resolved extreme ultraviolet (EUV) spectrometer is utilized to observe the spatial profiles of heavy impurities emission in the wavelength range of λ = 30–500 Å, as well as their temporal behavior, at the plasma core vertically from the midplane (Z = 0–450 mm) [4]. The tungsten unresolved transition array (W-UTA) between λ = 30–70 Å, as well as the C VI (33.7 Å) and Fe XXIII (132.9 Å) line emissions have been monitored with the EUV spectrometer for long H-mode EAST pulses with the application of RMP fields. Emission reductions in 40–70% for all impurities considered – considerably more than the ~20% decrease in electron density – have indicated the clear effects of RMPs for the control of impurities in the plasma core. Based on the spatial profiles measured by the EUV spectrometer, impurity transport coefficients, including diffusive coefficients and convective velocity are obtained with the help of the core impurity transport code, STRAHL. We seek to gain insights in understanding whether the W and Fe emission decreases are attributed solely to the reduction in heat flux from the ELM suppression or might also be caused by transport.

References

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