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Impact of plasma configuration on impurity and density control during long pulse discharges in EAST

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ABSTRACT

As a fully superconducting tokamak device, the Experimental Advanced Superconducting Tokamak (EAST) bears the mission to demonstrate high-power, long-pulse plasma operation with flexible plasma configurations [1]. In 2014, an ITER-like actively water-cooled tungsten (W) divertor was installed in EAST. The castellated monoblock structure in the W divertor facilitates the power handling up to 10 MW/m2. Presently, the plasma-facing materials (PFMs) in EAST include tungsten in the upper divertor, graphite in the lower divertor and molybdenum in the main vacuum chamber. The NBI shinethrough region at inboard first wall and the guard limiter of heating antenna at outboard are also covered with graphite tiles. Last year, the long pulses over 100 s in L mode and 60 s in H mode have been successfully achieved at a loop voltage close to zero with the ITER-like actively water-cooled tungsten divertor [2]. The well-controlled plasma-wall interaction (PWI) in the edge plays a critical role in the long pulse discharge. The runaway growth of plasma density often terminates the discharge in a long-pulse operation, which is found to be connected with the edge recycling. The plasma shaping has an important impact on the PWI behavior, including particle exhaust, neutral recycling, impurity control etc. It is observed that too small gap between plasma and inner wall can cause intensive interaction and excessive heating of the graphite tile, enhancing erosion of carbon and overturning the particle balance, consequently influencing the density control. The plasma configuration in divertor is another important factor. Moving the strike point close to the pump slot between dome and outer target can increase the efficiency of particle exhaust significantly, benefiting the density control. Moreover, a good match of plasma shaping and the curve of guard limiter of heating antenna not only provides a good power coupling and current driving effect, but also is indispensable to reducing the impurity content in plasma. The optimized plasma shaping in the lithium-coated wall environment contributes greatly to the successful achievement of long pulse operation in EAST.

Keywords: lithium and silicon coating; tungsten erosion; impurity concentration; spectroscopic diagnosis.
[1] Wan Y.X. et al 2006 Overview progress and future plan of EAST Project Proc. 21th IAEA FEC 2006 (Chengdu, People's Republic of China, 2006) (Vienna: IAEA) OV/1-1
[2] Wan B.N. et al 2016 Overview of EAST Experiments on the Development of High-Performance Steady-State Scenario 26th IAEA FEC (Kyoto,Japan, 2016)
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