Helium fuelling for edge plasma parameters control in thermonuclear experiments

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It is proposed to use helium component of the thermonuclear reaction as diagnostic test instrument for plasma parameters control in the divertor SOL. The He fraction of plasma could be useful for monitoring of the ITER full-W divertor in stationary or slow transient cycles during non-active He–H phases of DT operations [1, 2]. The helium line emission is sensitive to electron temperature and density and can be applied as effective diagnostics for these plasma parameters. This paper deals with FT-2 tokamak experiments where additional helium puffing into the hydrogen/deuterium plasma is considered as diagnostic tool [3]. In the dynamical tokamak experiments (LHCD and plasma current disruption), variations of *ne*(*r*) and *Te*(*r*) at the plasma edge were monitored with the use of the method based on the proportionality of the intensity ratios He I (668 nm)/He I (728 nm) and He I (728 nm)/He I (706 nm) of atomic helium spectral lines to the *ne*(*r*) and *Te*(*r*)*,* correspondingly. The pure helium plasma experiment was performed for verification of the calculated factors, which fit the relationship between the line intensity ratios and plasma parameters. Characteristic features of that calibration method are based on comparing of spectroscopic data with *Te* and *ne* measurements by multi-pass intracavity Thomson scattering and microwave interferometer.

The paper also focuses on the effect of helium fuelling of hydrogen/deuterium plasma on the anomalous heat transport development and suppression controlled by interaction of multi-scale turbulence, characterized by microwave Doppler backscattering diagnostics: correlative enhanced scattering [4] and reflectometry. The medium-scale geodesic acoustic mode (GAM) turbulence impacted by He puffing which result in changes of the GAM amplitude and frequency spatial profiles is compared with dynamics of the small-scale turbulence level profiles in the special regime with intensive helium fuelling.

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References

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