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P1.1042 Arc discharges at the plasma periphery during disruption in tokamak

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Development of the arc discharges in the peripheral plasma is considered as a possible mechanism determining transition from relatively slow growth of the large-scale MHD perturbations to thermal quench (minor disruption) and subsequent transition to a major disruption (current collapse). Development of the arc discharges can lead to a sharp increase in the interaction of the plasma with the first wall and limiters, accompanied by entry of impurities and neutral gas into the bulk plasma and formation of the unstable plasma configuration. This mechanism could be especially strong in experiments with all-metal (tungsten) first wall considered as baseline plasma-facing component in ITER.
Arc discharges are studied in the T-10 tokamak with tungsten limiters in plasma with relatively high density. Effects of the arc discharges are generally evaluated by postoperational inspection of the vessel components. Installation of the movable magnetic and electrical probes located near the plasma boundary at multiple positions inside the vacuum vessel (far and in the vicinity of the limiters, at the high and low field side of the torus) allowed identification of the fast-scale (0.5-2.0 MHz) electromagnetic perturbations attributed to the arc discharges. Simultaneous measurements of the x-ray intensity and analysis of the visible light images by fast-frame camera confirmed strong plasma-wall interaction during bursts of the fast-scale electromagnetic perturbations. Essential new feature of the T-10 experiments is installation of the new "ARC" probe with castellated surface stimulating arc discharges directly at the location of the electric probe with simultaneous measurements of the magnetic perturbations in the immediate vicinity of the arc zone. Experiments indicated that transition to major disruption is generally associated with enhanced currents to the "ARC" probe. In addition to the "passive" measurements of the arc perturbations, "active" experiments were conducted in the T-10 tokamak, with initiation of the currents in the peripheral plasma using biasing (U~0-400V) between different in-vessel components (vacuum chamber, limiters, and special movable electrode). Experiments indicated that critical surface current density is required for the arcs initiation. Parameters of electromagnetic perturbations measured in the experiments on T-10 tokamak are compared with the characteristics of oscillations during arc discharges on a laboratory bench.

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