In-situ leading edge induced thermal damages of melting and cracking on ITER-like W/Cu mono-blocks during long pulse operations in EAST

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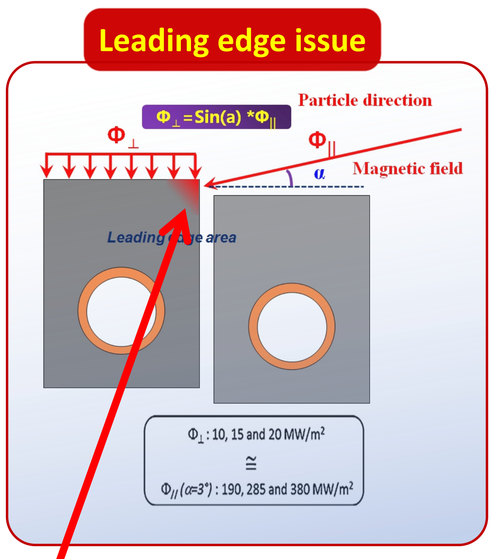
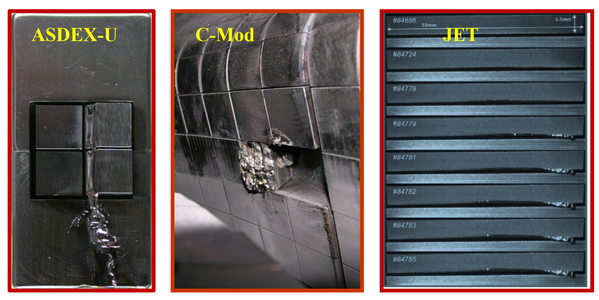
1 Leading edge issue in tokamak



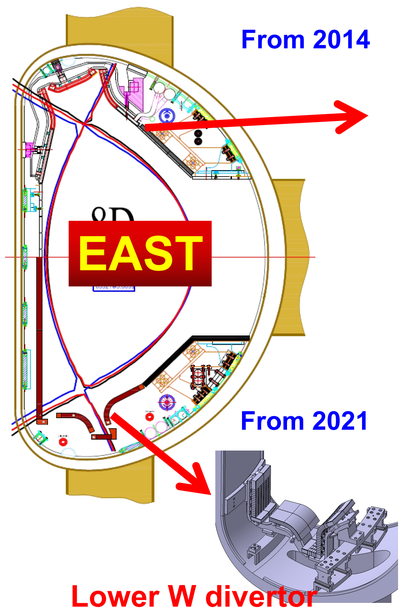
Over heating effect

Leading edge induced thermal effects due to assembly tolerance between neighboring plasma facing components is an critical issue in the future fusion devices, i.e. ITER, CFTER and fusion power plant using cassette structure for plasma facing surface.

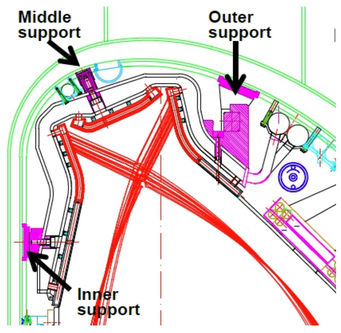


Melting during induced experiments

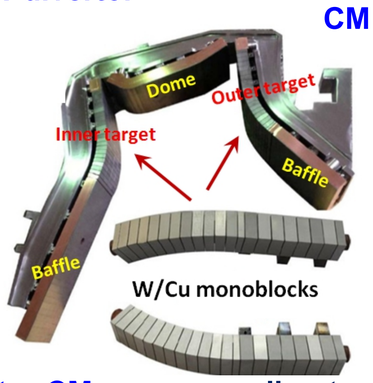
2 ITER-like W/Cu divertor on EAST



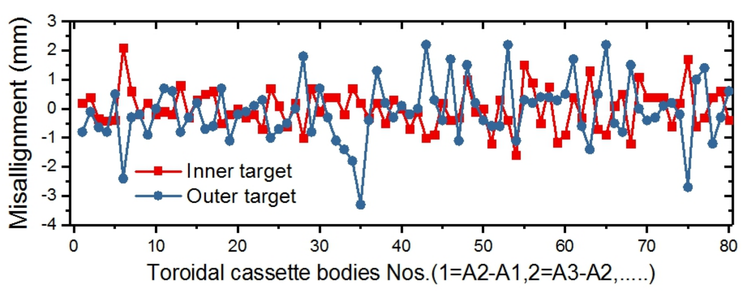
Upper W divertor



CM

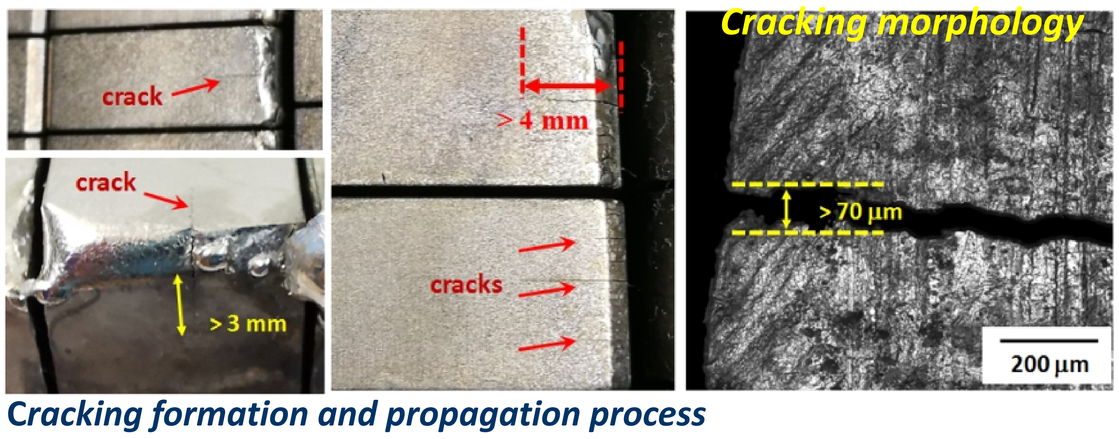


Misalignment at inter-CMs on upper divertor

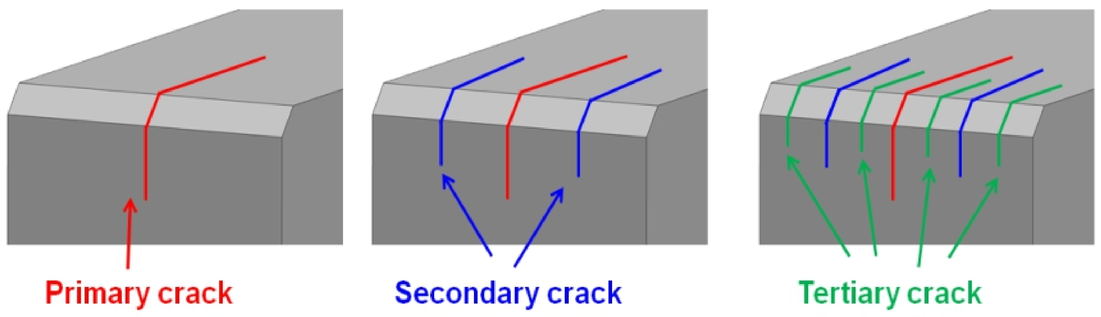


3 Cracking

(1) Cracking distribution and morphology

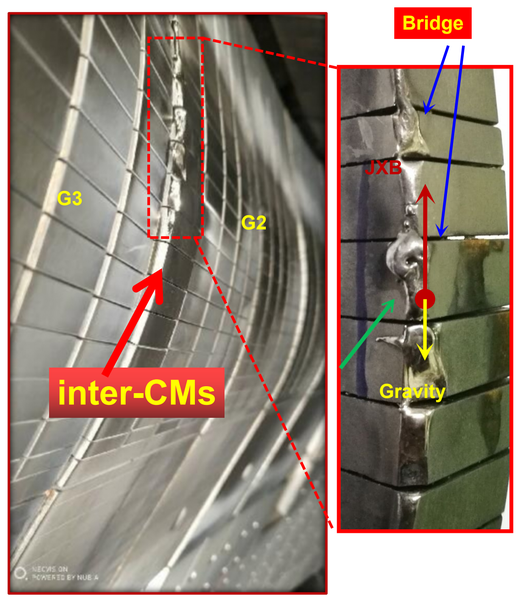


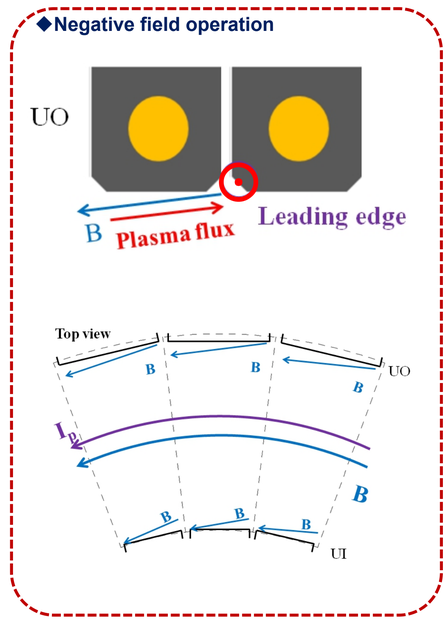
(2) Cracking formation and propagation process



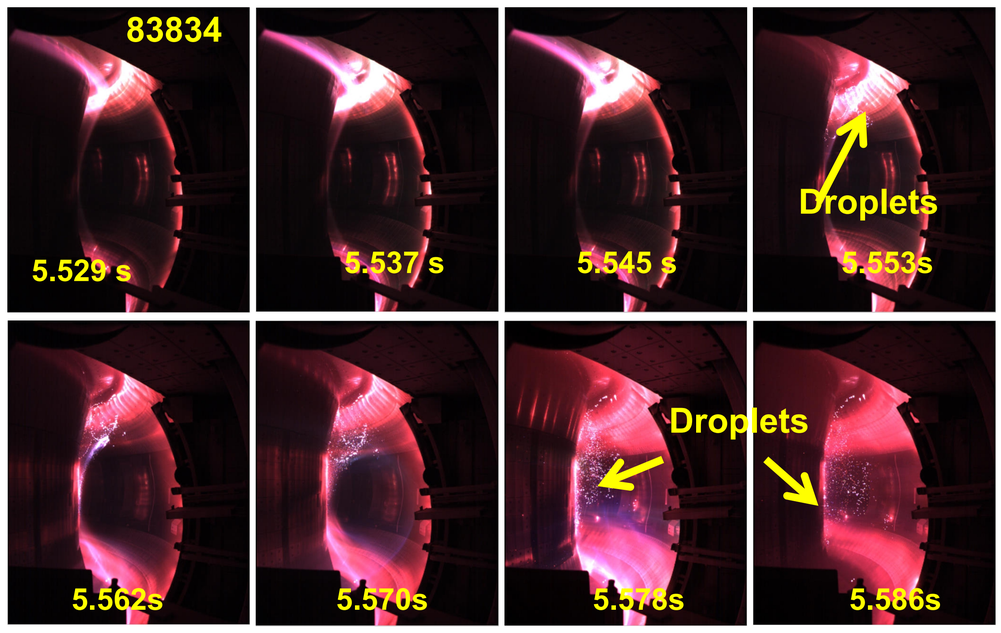
4 Melting

(1) Melting behaviors (Distribution, melted layer movement)

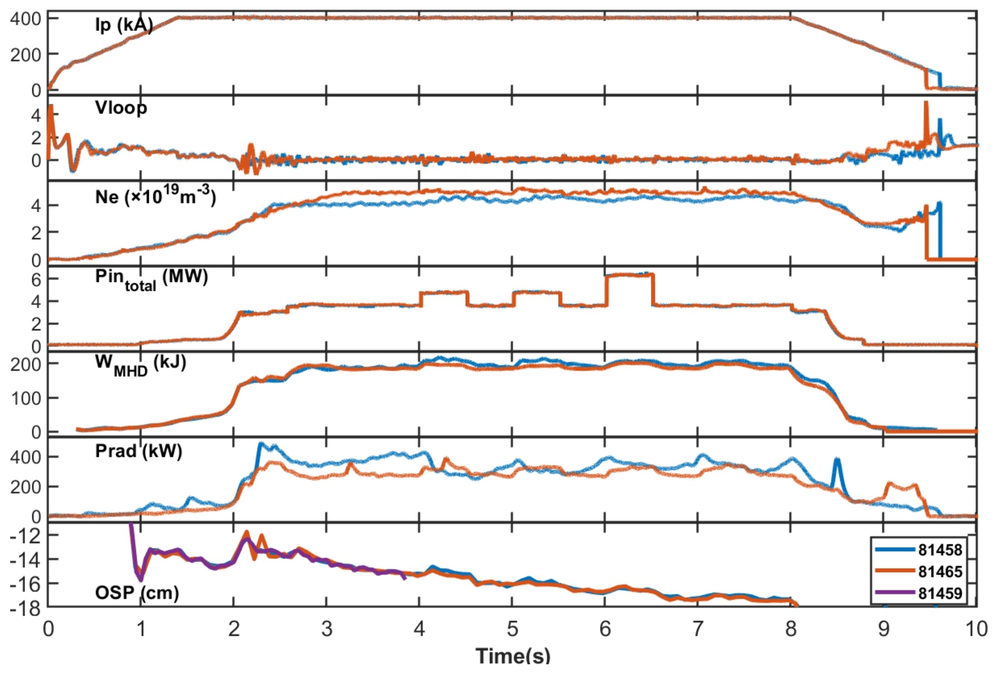




(2) Droplets ejection during L mode operation



(3) Melting influence on plasma discharge(disruption) and operation



 # 81458 : Normal # 81459 : Disruption (melting) # 81465 : simlar with #81458

→ Although plasma diruption by melting, subsequent plasma operation can continuce after some adjustment !

5 Conclusions

(1) The melting phenomena at inter-CMs both on inner and outer targets were observed with large number of droplets ejection from divertor by CCD camera, which were also identified by the post mortem inspection. Meanwhile, a lots of cracks with width of several m and depth of several mm along torodial and radial direction were also found universally at the leading edges.

(2) In spite of the subsequent plasma dishcarges, to some extent, could be operated with damaged monoblocks, the influence of such kinds of damages cannot be ignored. In particular, plasma quenched directly after droplets ejection were still often observed during long pulse operation.

(3) It can be foreseen that the leading edge induced thermal damages will become more serious with gradually increasing of perpendicular heat load up to 10 MW/m² in the future, which should be given special concern.

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