Electric field and hot spots formation on the divertor plates

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Intensive erosion of divertor plates could lead to formation of corrugate wedge-type shape of W-brush tungsten divertor plate in fusion reactor [1,2]. We consider here a sheath region bounded by a corrugated surface of divertor plate and a flat boundary held to a constant voltage bias. The rough surface influences the equipotential lines next to surface and can considerable enhance erosion due to the electric arcs initiation. The arcs, triggered by abnormal electric field at wedge-like edges of the W-brush tungsten divertor plates are strongly limiting the life-time of PS components and contaminate reactor plasma with impurities and dust particles during the reactor operation. In the paper the mechanism of arc formation and development of hot spots are considered. Analysis shows that the sharpening of surface roughness due to erosion increases the electric field at the vicinity of the wedge tips (see Fig.1). The enhanced electric field could trigger arcs and initiate hot spots on the tungsten material surface. The conditions for triggering are derived. The high probability of the hot spot formation and arcs initiation on the diverter plates caused by surface distraction during the multiple transient events is confirmed in calculations for tungsten and other materials which are envisaged for divertor plates in tokamak reactor.

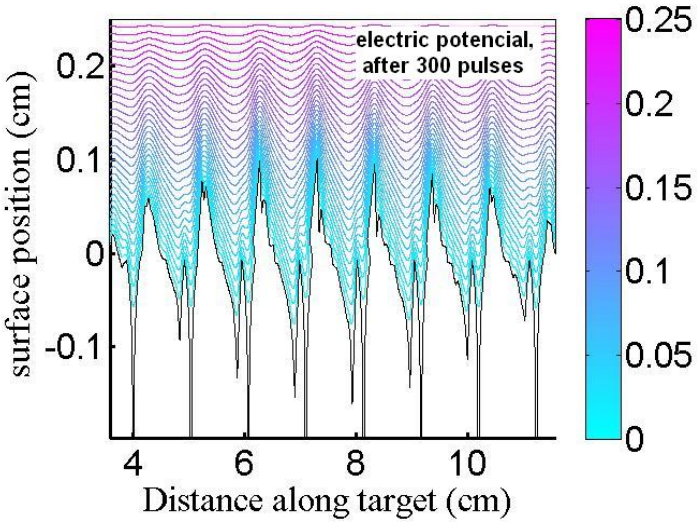

Figure 1: Contours of equipotential lines, graduated as shown on the right hand side of the picture; W-brush target corrugated under 300 ELM-like pulses (heat loads of 1.6 MJ/m^2, τ =0.5 ms) [1].

[1] B. Bazylev et al., J. Nucl. Mater. 337-339 (2005) 766-770
[2] B. Bazylev et al, B.Physica Scripta. T128 (2007) 229