IAEA FEC 2014

Contribution ID: **206** Type: **Poster**

# Unipolar Arcing at Advanced Fine-Structured Materials

*Friday 17 October 2014 08:30 (4 hours)*

Novel approaches for the fusion devices first wall include materials with 'advanced' surface structures. The general idea is the creation of a specific layer (of a micron size) at the first-wall surface. Most promising are - liquid-metal at a capillary-porous structure [1-2], and recently discovered tungsten 'fuzz' structure that consists of metal nanowires [3-5]. The advantages of these surfaces are - low sputtering yield, reducing of surface cracking etc. However, there is an undesirable feature - the promotion of the self-sustained unipolar arcs that can be ignited more easily at such film-like surface [6-7].
It has been found that the arcing is promoted by the pulsed action of ELM-plasma, and that arc cathode spot burn in the tungsten layer of a few-micron size [8-9].
Vacuum arc investigations on film cathodes [10] strongly promotes the understanding of physics of whole 'vacuum discharge' [11-13].
The vacuum discharge implies a formation of plasma from the electrode material for a large current transfer. It consists of three stages - vacuum breakdown, vacuum spark, and final - vacuum arc. The basic feature of all these stages - explosive electron emission (EEE) pulses - ectons that arise from microcenters at the cathode and are responsible for an electron emission current of a large density and large magnitude.
The model of unipolar arcing [7,14-15] will be further improved with taking into account the ignition of the EEE pulses under the external action of plasma and power fluxes at a surface microstructure.

[1] Hirooka et al 2010 Nucl. Fusion 50 077001
[2] Mirnov et al 2006 Plasma Phys. Control. Fusion 48 821
[3] Kajita et al 2007 Nucl. Fusion 47 1358
[4] Doerner, Baldwin and Stangeby 2011 Nucl. Fusion 51 043001
[5] Wright et al 2012 Nucl. Fusion 52 042003
[6] Kajita et al 2009 Nucl. Fusion 49 032002
[7] Barengolts, Mesyats, Tsventoukh 2010 Nucl. Fusion 50 125004
[8] Herrmann 2009 J. Nucl. Mater. 390-391 747
[9] Rohde 2011 J. Nucl. Mater. 415 S46–S50
[10] Kesaev 1968 'Cathode Processes of Electrical Arc', Nauka, Moscow
[11] Mesyats and Proskurovsky 1989 Pulsed Electrical Discharge in Vacuum (Berlin: Springer Verlag)
[12] Mesyats 2013 IEEE Trans. Plasma Sci. 41 676
[13] Anders 2008 Cathodic Arcs (Springer, NY)
[14] Barengolts, Mesyats, Tsventoukh, 2008 JETP 107 1039
[15] Barengolts, Mesyats, Tsventoukh 2011 IEEE Trans. Plas. Sci. 39 1900

## Country or International Organisation

Russian Federation

## Paper Number

MPT/P7-34

**Author:** Dr TSVENTOUKH, Mikhail (Lebedev Physical Institute RAS)

**Co-authors:** Prof. MESYATS, Gennady (Lebedev Physical Institute RAS); Dr BARENGOLTS, Sergey (Prokhorov General Physics Institute RAS)

**Presenter:** Dr TSVENTOUKH, Mikhail (Lebedev Physical Institute RAS)

**Session Classification:** Poster 7