EUROfusion

WP PWIE SPA4 (2021): KIPT
D05: Influence of plasma pre irradiation with heat loads near surface recrystallization on surface damaging with heat loads above the melting threshold

Vadym Makhlai, Igor Garkusha, S.S. Herashchenko, Yu.V. Petrov, N.N.Aksenov, O.V. Byrka, V.V. Cheboratev, N.V. Kulik, V.V. Staltsov and QSPA team

KIPT

Kharkov Institute of Physics and Technology
Institute of plasma physics, Kharkiv, Ukraine

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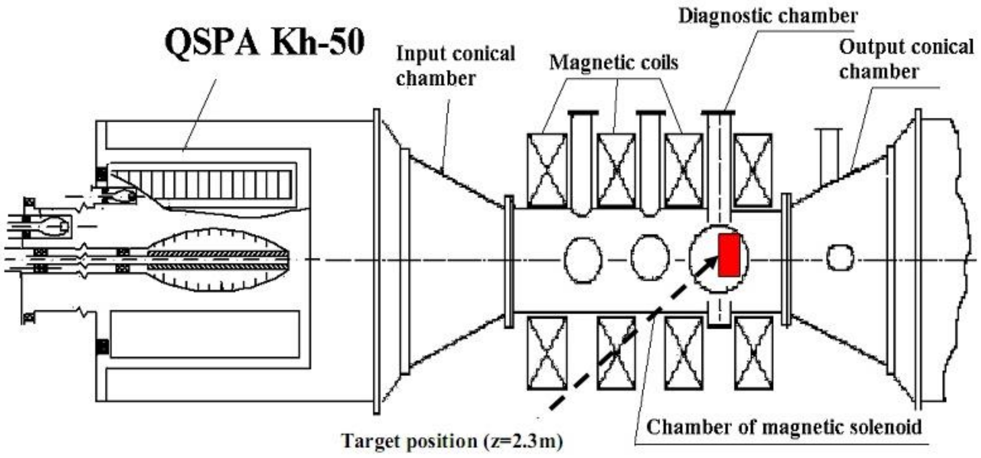
Experimental facilities: QSPA Kh-50; QSPA-M



Diagnostics

- ❖Calorimetry
- ❖Optical emission spectroscopy
- ❖High-speed digital camera PCO AG

Parameters of QSPA Kh-50 plasma streams

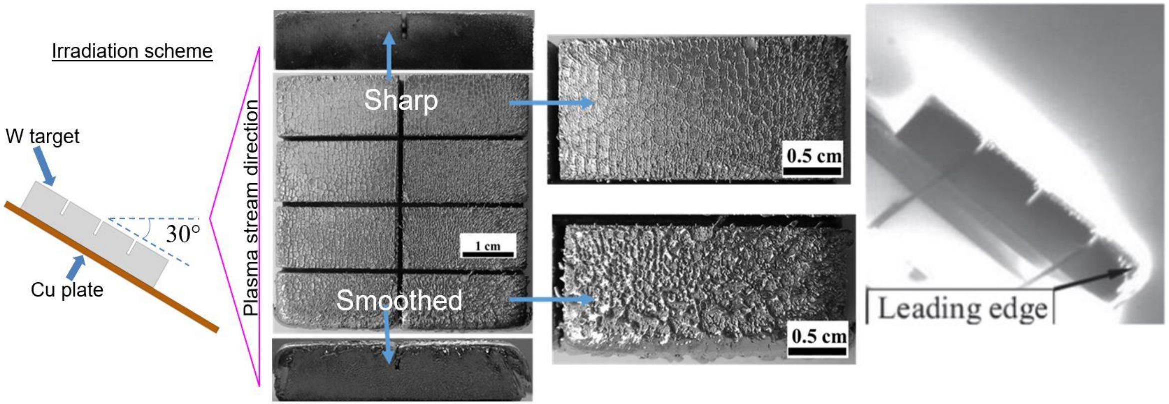
Plasma energy density, MJ/m^2	2.0
Plasma pressure, MPa	0.32
Plasma pulse duration, ms	0.25
Heat load on the leading edge, MJ/m^2	0.9
Heat load on the center of sample surface, MJ/m^2	0.6
Angle inclination, degree	30
Plasma stream diameter (cm)	18
Impact energy of ions (keV)	0.4

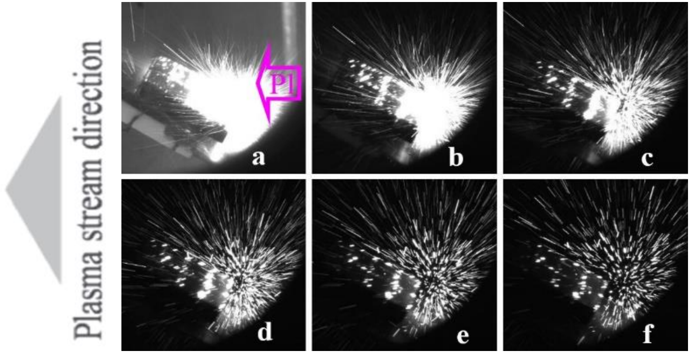
V A Makhlai et al *2020 Phys. Scr. T171, 014047*

- Tungsten material damaging in QSPA under plasma loads which are caused a pronounced surface melting.
- Characterization of dust in QSPA experiments. Stick effects at the surface.

Sp A.4: Ongoing work of 2021

Collection of liquid/dust particles ejected from castellated surfaces of different shapes irradiated by QSPA Kh-50 at simulating an unmitigated ELM in fusion reactors.



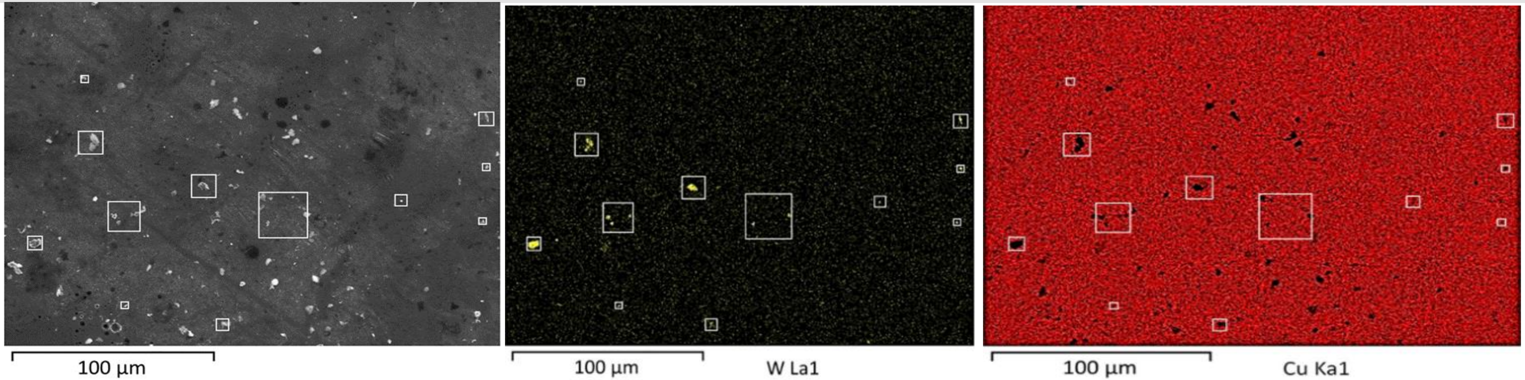


The particles ejection during PSI with the sharp leading edge of the castellated target

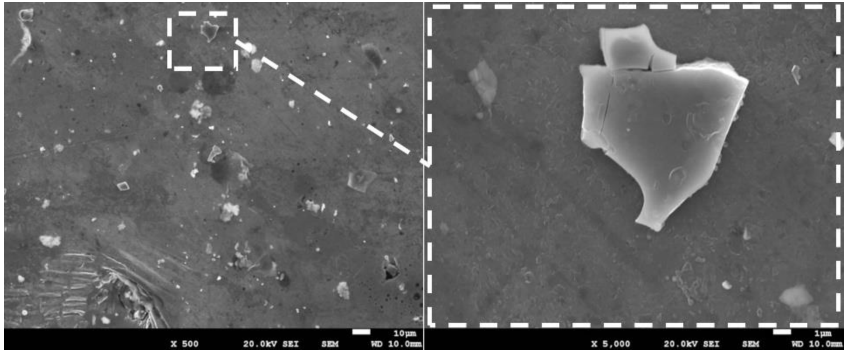
The no-uniform shielding layer was created during interaction plasma with oblique surfaces. The non-homogeneous distribution of the energy density along the exposed surface was observed at the inclined plasma impact. As a result, the damaging of various target parts was significantly different.

A special plate (**Cu**) was placed on the back side of the target (**W**) for the collection of erosion products, which ejected from the exposed surfaces.

SP A.4 Ongoing work 2021



The SEM image (a), the EDX elemental mapping (b, c) obtained for the Cu collecting plate



Results were presented on PFMC-18 paper submitted to *Physica Scripta*

Both the re-solidified droplets as well as the dust particles have been collected on the plate near the exposed surfaces.

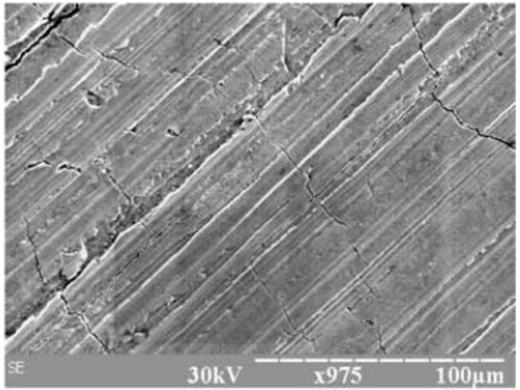
Solid dust is majority of the particles ejected from castellated tungsten surfaces.

It is mainly attributed to the cracking during the surface cooling.

SP A.4 : Outline task for 2022 KIPT

Plasma heat loads which causes surface recrystallization and changes in Microstructure and melt threshold

- Tungsten material damaging in QSPA under giant ELMs/disruption like loads which are caused a pronounced surface melting.
- Contribution of plasma heat loads which causes surface recristallisation on the decreasing of the melting threshold



Example of fatigue cracks after 150 QSPA pulses of 0.45 MJ/m^2 (1000 K $<\Delta T_{surface} <$ 1500 K) below tungsten melting threshold . Development of cracks obviously leads to local deterioration of the heat conductivity in cracked volume

I.E. Garkusha et al. / Journal of Nuclear Materials 386–388 (2009) 127–131