



WP PWIE SPA1 (2021): KIPT

D005: Qualification of current baseline materials under transient (HHF plasma load with QSPA) and steady state loading (PSI-2, JUDITH) (KIPT)

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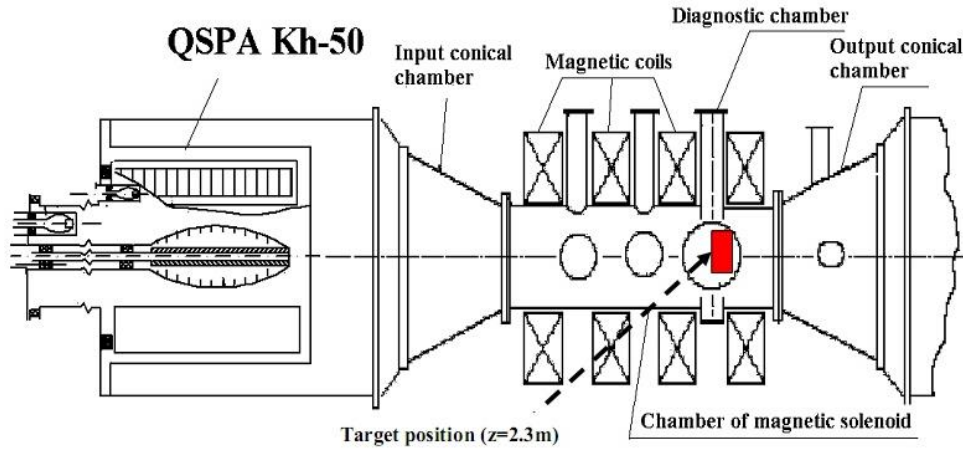


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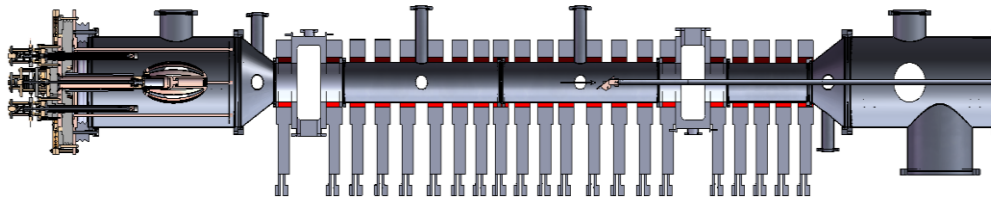
Experimental facilities: QSPA Kh-50; QSPA-M



Plasma energy density	0.1–2.2 MJ/m²
Plasma load duration	0.25 ms
Diameter of plasma stream	15 cm

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

QSPA-M



Plasma energy density	0.1-1 MJ/m²
Plasma load duration	0.1 ms
External magnetic field	0.8 T
Diameter of plasma stream	6 cm

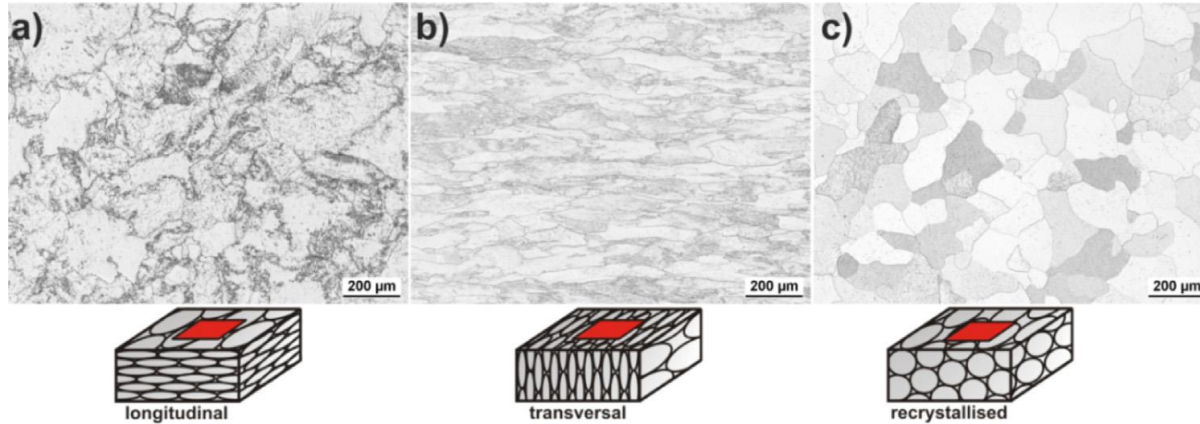
Diagnostics

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

I.E. Garkusha et al 2017 Nucl. Fusion 57, 116011;
I.E. Garkusha et al 2019 Nucl. Fusion 59, 086023



- Post-mortem analysis will characterize the induced surface modifications and damages as well as investigate changes of the materials properties due to e.g. recrystallization behavior and/or surface morphology changes
- Studies of fatigue cracks formation in deformed/re-crystalized W, fatigue damage of W_f/W wires, latticing W etc. (delay till delivered of samples of baseline materials)
- The 12 polished samples of the IGP W material with transversal grain orientation were provided by Marius Wirtz as link between WP MAT at August 2021



Tungsten samples were supplied by Plansee AG (Austria), prepared and delivered from Forschungszentrum Julich (Germany). Samples have sizes of $12 \times 12 \times 5 \text{ mm}^3$.

the longitudinal (L) transversal (T) grain orientation and in the recrystallized (R) state.

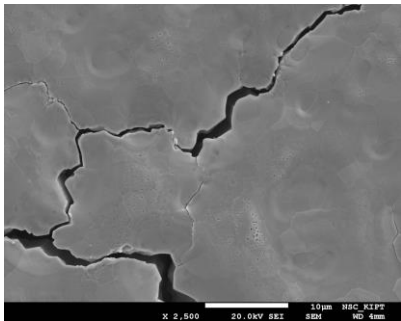
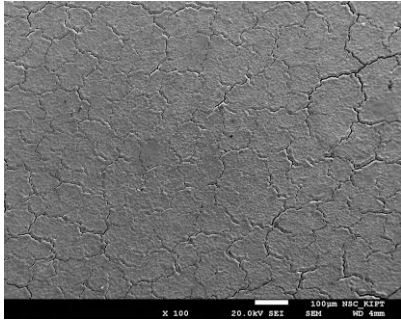
Transversal target demonstrated best resistance under heat load below melting threshold

TLR tungsten samples was irradiated by 200 QSPA pulses to each sample in 2020 ($q_{(\text{surf})} = 0.75 \text{ MJ/m}^2$ (47,25 MWsq(r) m⁻²) $\tau_{\text{pulse}} = 0.25 \text{ ms}$; $T_{\text{base}} = 400 \text{ C}$);

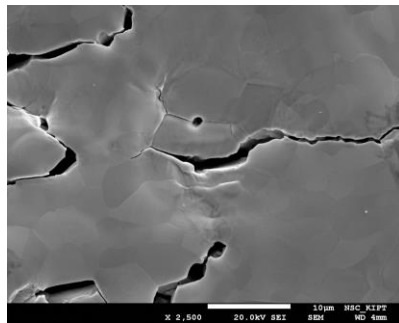
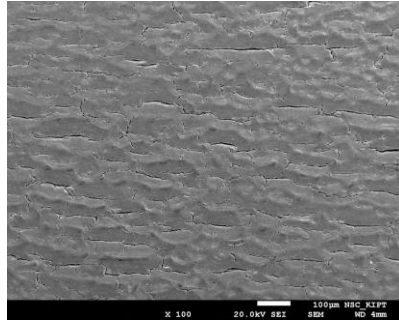
Above melting threshold



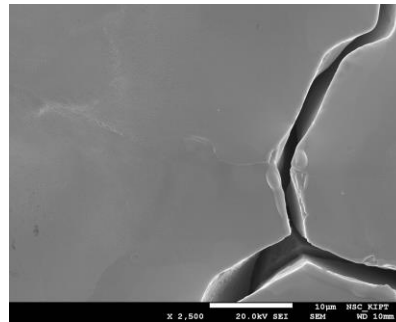
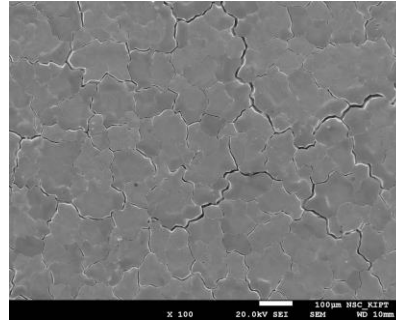
T
transversal



L
longitudinal



R
recrystallized



- Resolidified layer
- Micro-crack networks

- XRD analysis of samples as well as cross section are in progress



Outline task for 2022

- Synergy effects from sequential stationary (PSI-2 / MAGNUM-PSI) and transient (QSPA) plasma loads. (DIFFER, MPG, FZJ, KIPT)
- Combination of pulsed and steady state loading (e.g. behaviour of QSPA pre-damaged targets in PSI-2, JUIDTH compared with reference samples) (FZJ, KIPT)