PWIE SPA.1 midterm 2021: CIEMAT

D0003: Qualification of OLMAT as HHF facility in comparison with QSPA and GLADIS

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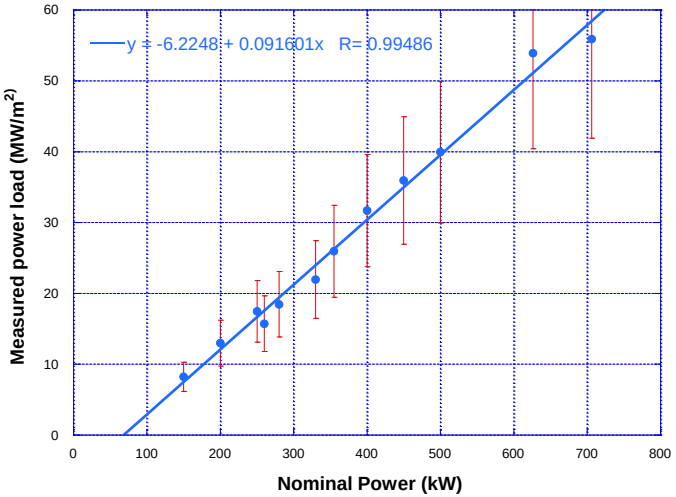
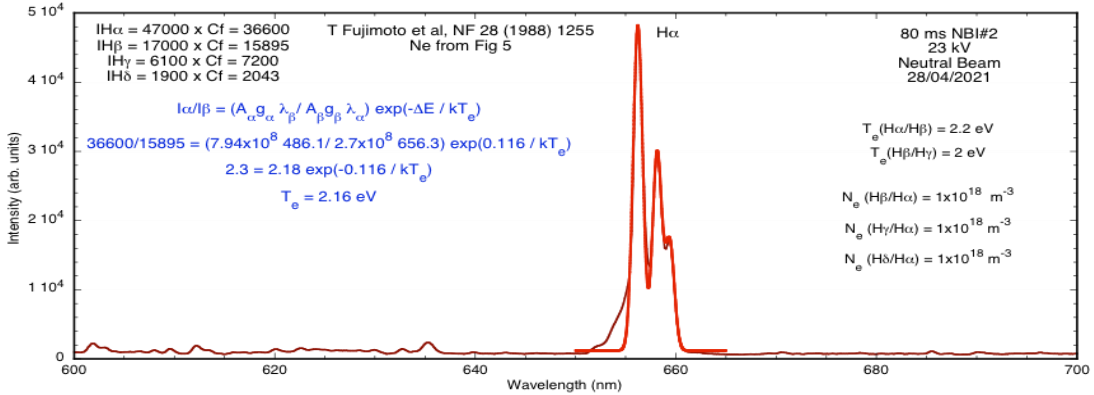
This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 and 2019-2020 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.

COMISSIONING: capabilities

2 short campaigns (4+7 days)

- **Maximum injected power: 705 kW**
- **Maximum pulse length: 150 ms** (at medium power)
- **Pulse repetition rate: every 30s for 100 pulses** (so expected ~1000/day)
- **Develop cold plasma: T_e: ~2eV; n_e: 10^{18} m^{-3}** (spectroscopy)

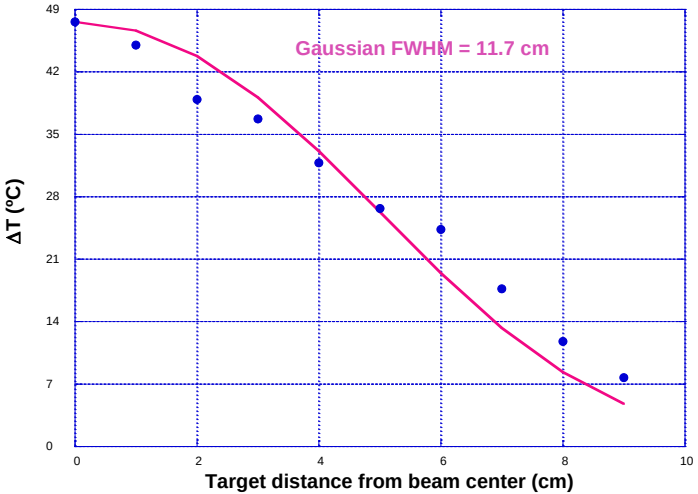




COMISSIONING: results

2 short campaigns (4+7 days)

- Up to 705 kW, 150 ms. Every 30s for 100 pulses. T_e: ~2eV; n_e: 10^{18} m^{-3}
- **Maximum heat loads at target: 60±15 MW/m²** (TC and pyrometry)
- **Maximum T surf: >1450ºC** (melting SS 304 cup); **>3422ºC** (melting W mesh)



SS cup fully melted.

Long time at >1450 ºC

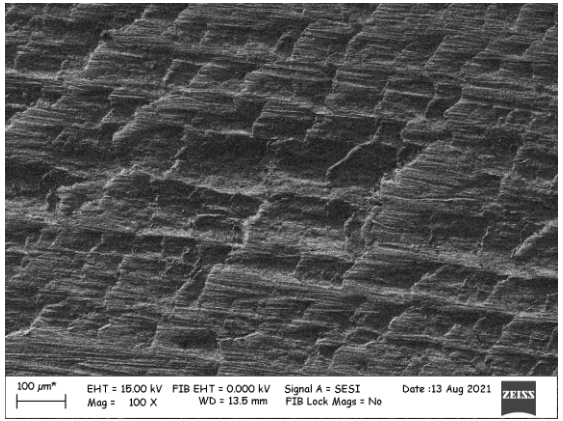
W mesh melted because of poor thermal contact

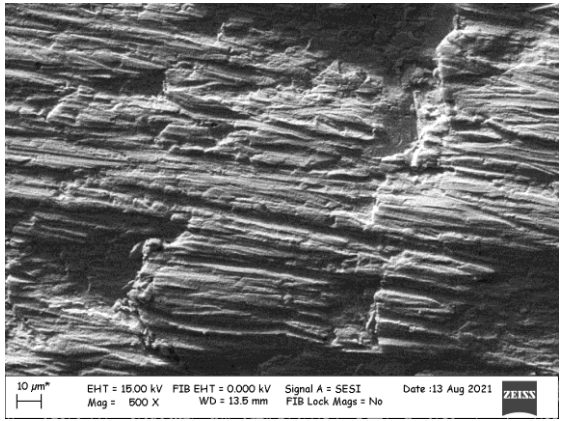
Protected by liquid Sn

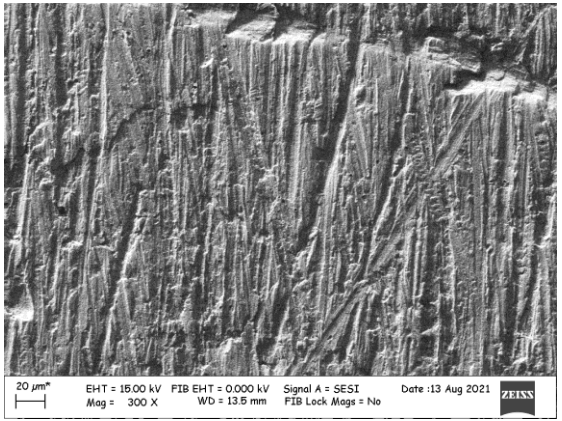
COMISSIONING: results

2 short campaigns (4+7 days)

- Up to 705 kW, 150 ms. 30s for 100 pulses. T_e: ~2eV; n_e: 10^{18} m^{-3}
- 60±15 MW/m^2; T surf: >1450ºC
- **No obvious damage in dummy sample** (thick TZM disc)**.**



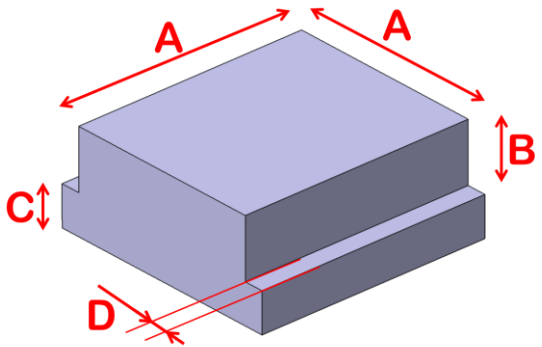




Comparison: Judith

10 square W samples.

- **Same as the ones used in Judith.**
- **Only inertial cooling at OLMAT yet:** low vertical temperature gradient.
- **30-150 ms pulses in a wide beam vs e^- cannon scanning.** Comparison is not straightforward (as with any other device!)

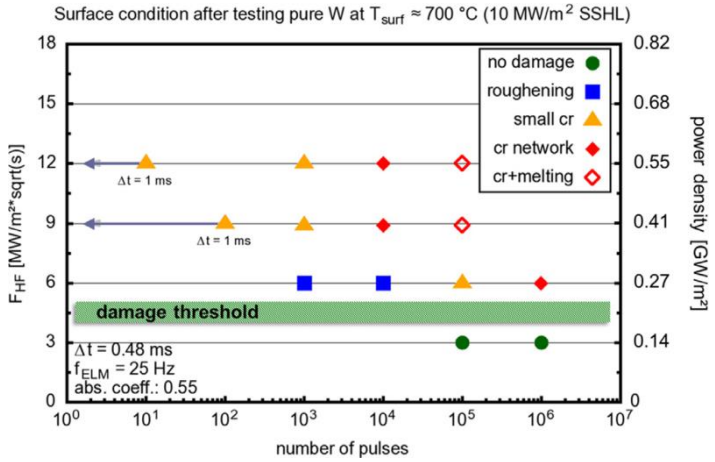


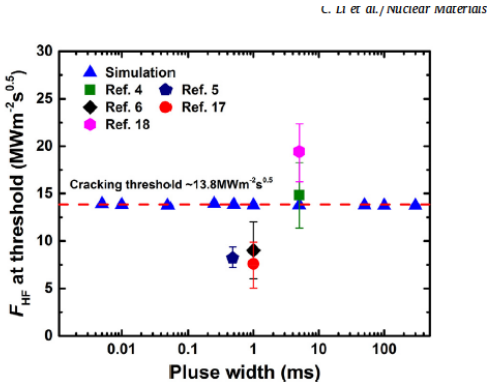
Probe Main dimensions	A (mm)	B (mm)	C (mm)	D (mm)	Maximum amount per mounting
5mm Probe	5	2 [0;50]	3]0;10]	1	12
10mm Probe	10	2 [0;50]	3]0;10]	1	8
15mm Probe	15	2 [0;50]	3]0;10]	1	4
20mm Probe	20	2 [0;50]	3]0;10]	2	2

Comparison: Judith

10 square W samples. Tentative experiments:

- **3 batches of 3, 1 in reserve. 2 weeks at the end of year.**
- **Experiments like in M. Wirtz, et al, Nucl Mat. Ener. 12 (2017) 148:**
  I. 1 full day (~1000 pulses) at 10 MW/m^2 and ~700 ºC and F_{HF} ~ 3 MW/m^2 s$^{0.5}$.
  II. 4 full days (~4000 pulses) at 10 MW/m^2 and ~700 ºC and F_{HF} ~ 3 MW/m^2 s$^{0.5}$.
  III. 1 full day (~1000 pulses) at 10-20 MW/m^2 and ~700 ºC and F_{HF} ~ 4.5-6 MW/m^2 s$^{0.5}$.





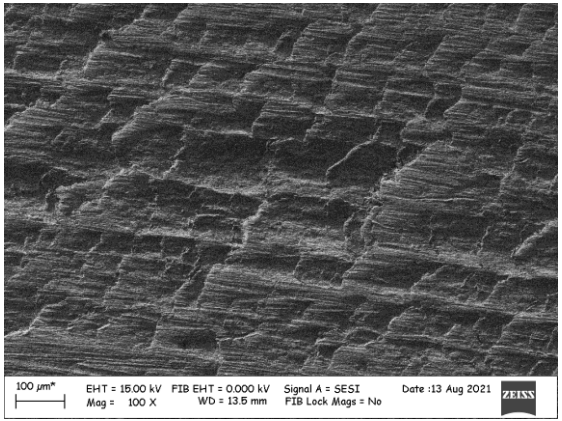
The Heat Flux factor is independent of pulse duration

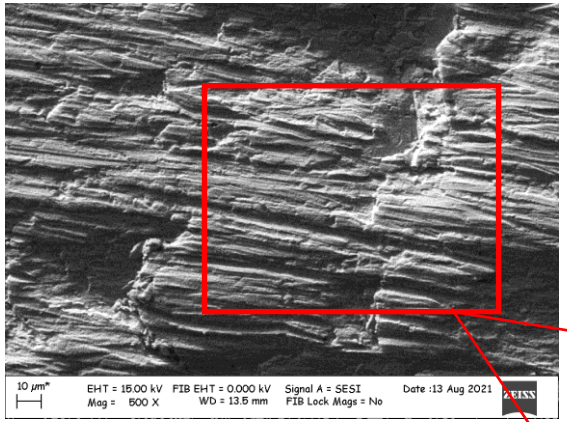
SUMMARY

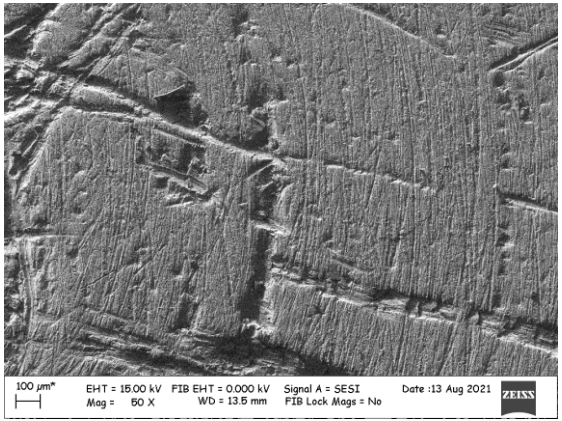
- **Successful commissioning of OLMAT**
- **Good parameters:** pulse every 30s, 60±15 MW/m^2, melt SS, etc.
- **Experiments to compare with Judith planned.** W samples on the way.
- **Future: continue comparison with GLADIS (similar device)**

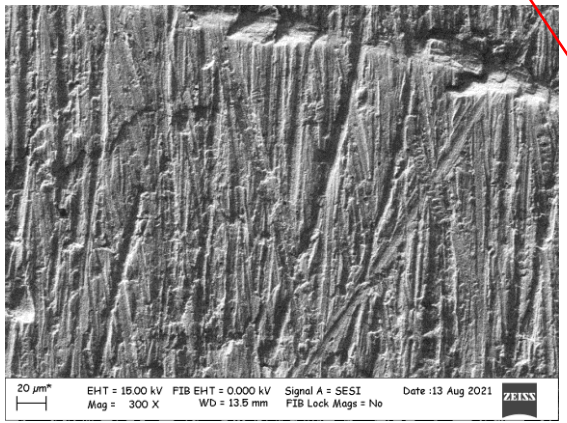
Reserve slides

Muestra 058. OLMAT, tapa y junta (pieza grande de TZM, según interpreto del email de DA). Imágenes SEM

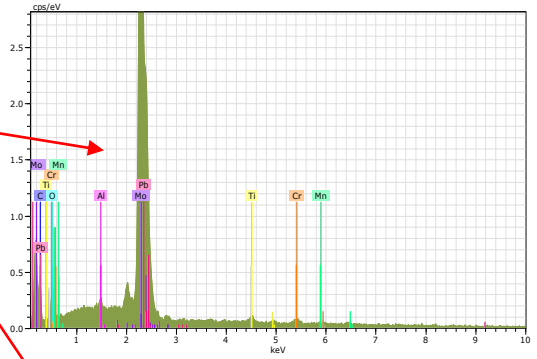








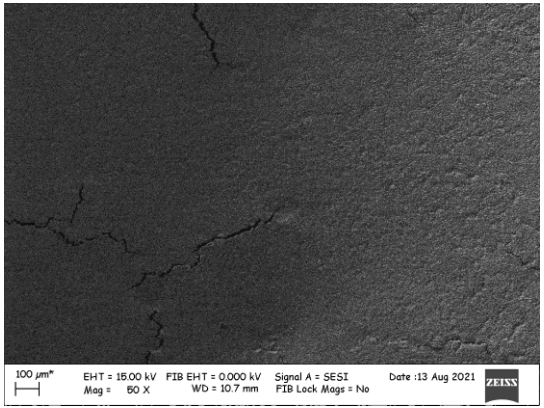
Se estudian ambas, aunque sólo parece ser necesaria la tapa, a quien corresponden estas imágenes.

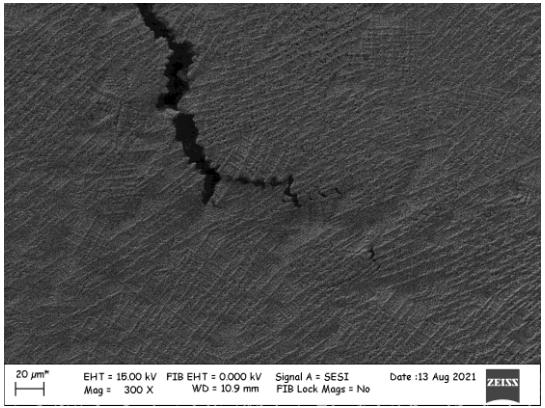


Spectrum: OLMAT tapa y junta 2

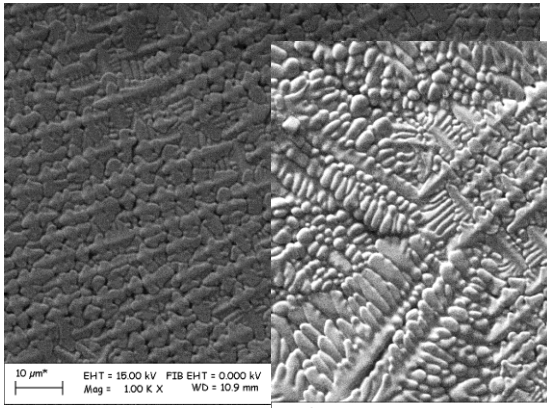
El	AN	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error (1 Sigma) [wt.%]	K fact.	Z corr.	A corr.	F corr.
C	6	K-series	5.19	5.19	28.06	0.29	1.000	3939.677	0.128	1.000
O	8	K-series	5.13	5.13	20.80	0.28	1.000	973.560	0.138	1.000
Al	13	K-series	0.62	0.62	1.49	0.05	1.000	87.850	0.565	1.000
Ti	22	K-series	0.80	0.80	1.09	0.05	1.000	4.388	0.826	1.000
Cr	24	K-series	0.88	0.88	1.09	0.05	1.000	2.470	0.889	1.000
Mn	25	K-series	0.26	0.26	0.30	0.03	1.000	1.817	0.912	1.000
Mo	42	L-series	54.64	54.64	36.98	1.49	1.000	9.263	0.804	1.000
Pb	82	M-series	32.49	32.49	10.18	0.90	1.000	4.631	0.793	1.000
		Total:	100.00	100.00	100.00					

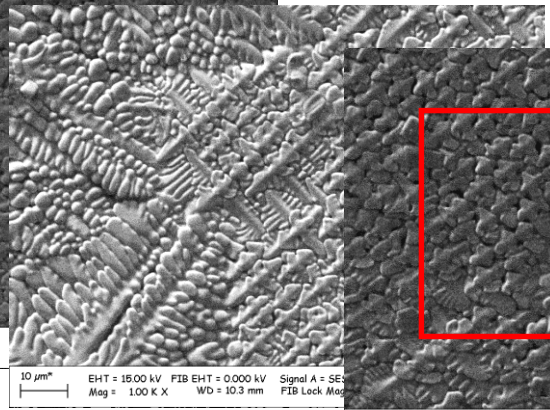
Muestra 058. OLMAT, tapa y junta (pieza grande de TZM, según interpreto del email de DA). Imágenes SEM

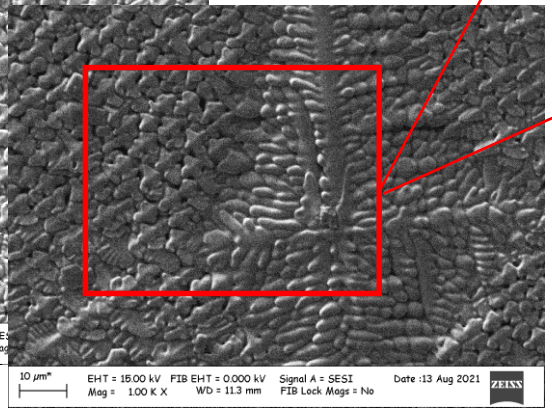


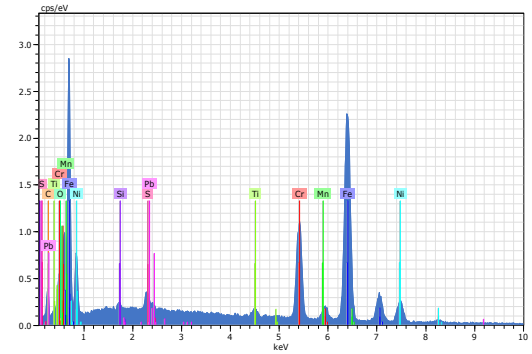


Imágenes y análisis correspondientes a la junta de acero fundido.









Spectrum: OLMAT tapa y junta 5

El	AN	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error (1 Sigma) [wt.%]	K fact.	Z corr.	A corr.	F corr.
C	6	K-series	3.37	3.37	13.69	0.19	1.000	2964.764	0.139	1.000
O	8	K-series	0.64	0.64	1.96	0.05	1.000	732.643	0.353	1.000
Si	14	K-series	0.34	0.34	0.60	0.04	1.000	46.535	0.547	1.000
S	16	K-series	0.78	0.78	1.19	0.05	1.000	22.905	0.725	1.000
Ti	22	K-series	1.05	1.05	1.07	0.05	1.000	3.302	0.944	1.000
Cr	24	K-series	18.43	18.43	17.31	0.49	1.000	1.858	0.966	1.000
Mn	25	K-series	0.21	0.21	0.18	0.03	1.000	1.367	0.972	1.000
Fe	26	K-series	62.39	62.39	54.54	1.59	1.000	1.040	0.962	1.000
Ni	28	K-series	10.82	10.82	9.00	0.30	1.000	0.573	0.934	1.000
Pb	82	K-series	1.97	1.97	0.47	0.08	1.000	3.485	0.715	1.000
		Total:	100.00	100.00	100.00					