EB-1200 Experiments on W-rod Erosion

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Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,
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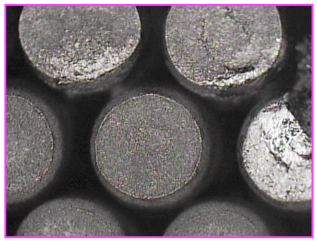
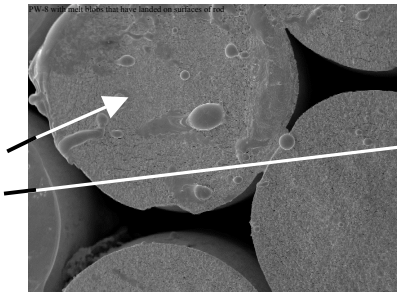
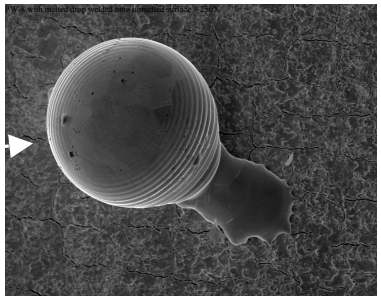
Failure occurs by high temperature W-oxide formation and erosion (vaporization) or by localized melting.

PW-10 after EBTS tests and before EB1200 tests

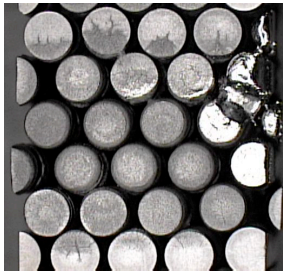


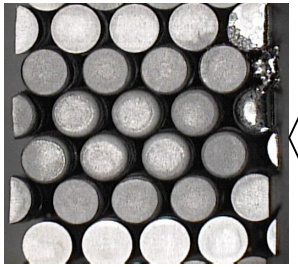
PW-8 melt droplets
self-welded droplet





PW-14 shows same erosion after EB1200 testing to 12 MW/m^2

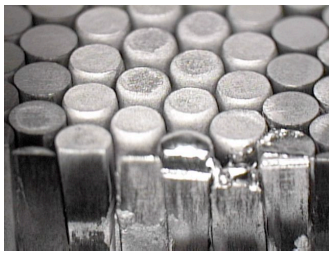




PW10 surface A. Rounded tips show severe erosion and surface melting, upper right. Rods splayed.

PW10 surface B.

edge view



Melted rods tips and "cup" shape of eroded rod tips are apparent.

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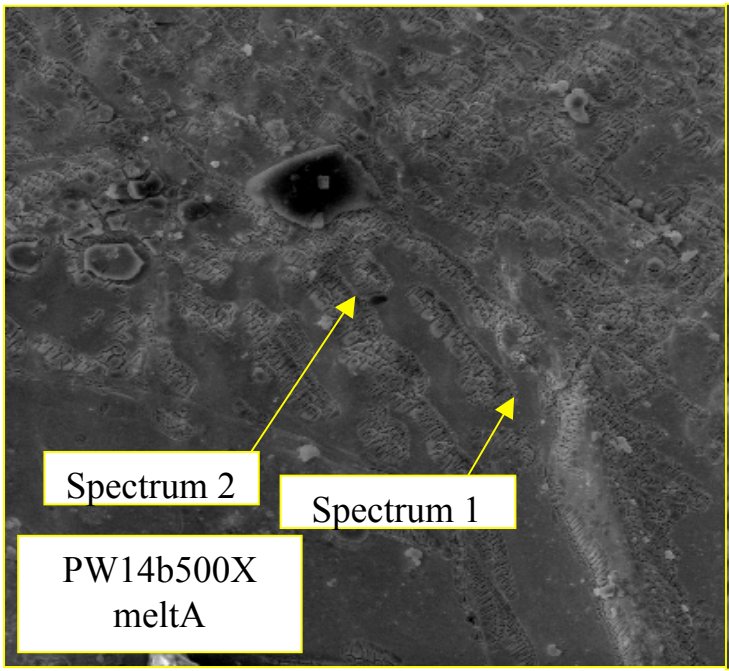
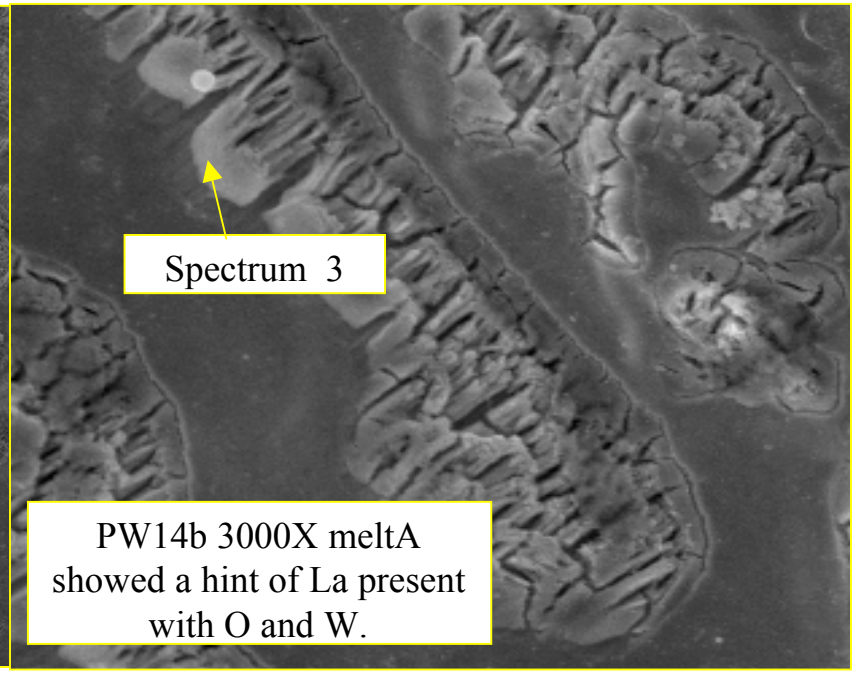
1.5% lanthanated tungsten rods erode at temperatures well below the melting point.

- W m.p. = 3695 K
- La m.p. = 3743 K

WO_2 m.p. = 1773 K; b.p.=2000 K
WO_3 m.p. = 1743 K; b.p.=2110 K
La_2O_3 m.p. = 2578 K; b.p.=4473 K





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W-rod armor erosion concerns

- **Vaporization >5800 K** — **disruptions**
- **Melt layer stability ~3600 K** — **ELMS**
- **Oxide formation >2000 K** — **normal operations**

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Vapor pressure

W: 10^{-8} Torr at 2200 K
32 mTorr (4.3 Pa) at 3680 K
La: 10^{-9} Torr at 1200K

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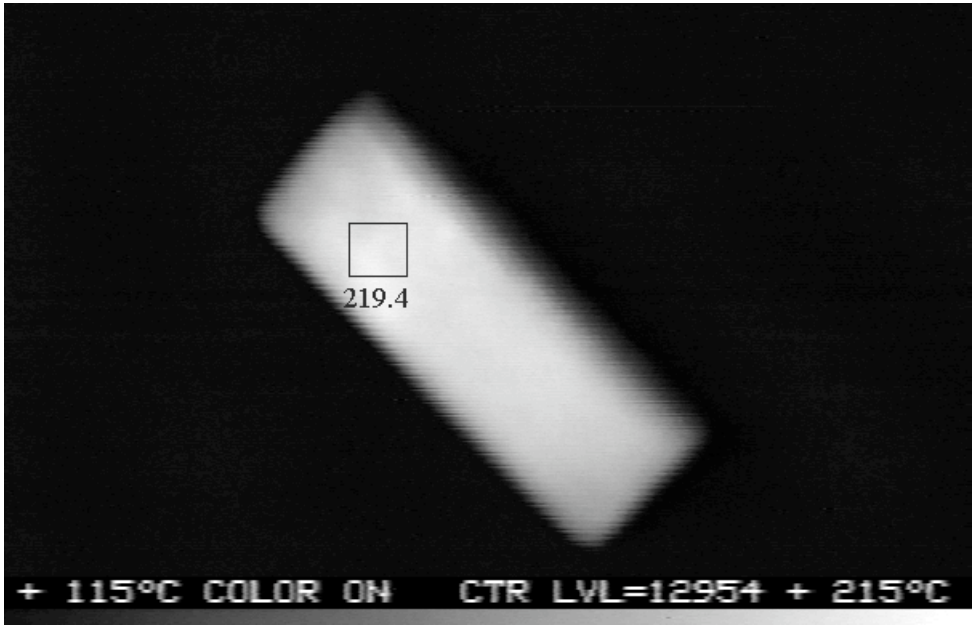
On 15Q we obtain surface temperature distributions during thermal response tests.



1.5 MPa, 10 m/s, 20 C water cooling, Y=1.5

- **Will record spectrum at 100 K intervals to 3300K**

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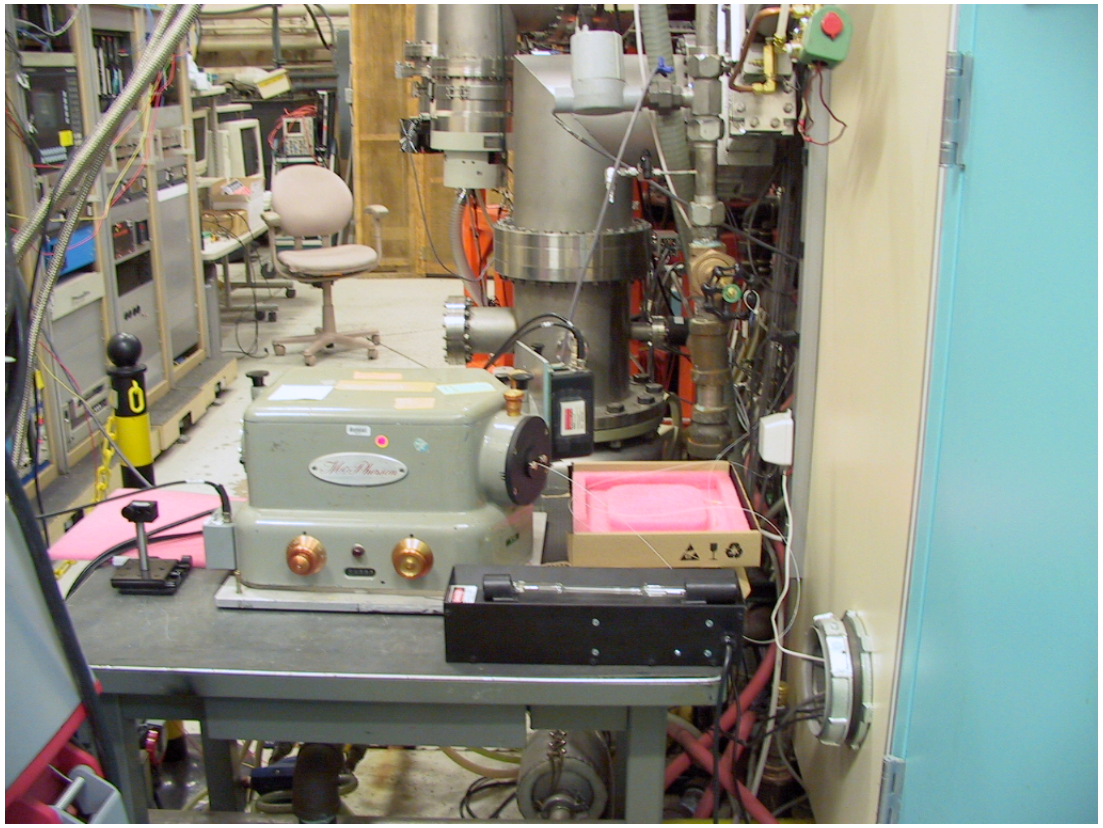
EB-1200 now equipped with optical emission spectroscopy.

Multiple fiber McPherson 30 cm monochromator



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HHF testing conducted with ELMS simulations

- Plan to use optical emission spectroscopy to show evidence of tungsten and tungsten oxide evolution.
- To date: no evidence of emission below 1200 K.
- Expect temperature must exceed 1700 K before spectra are attainable.