Smart Tungsten Alloys for Safer Operation of Future Fusion Power Plants

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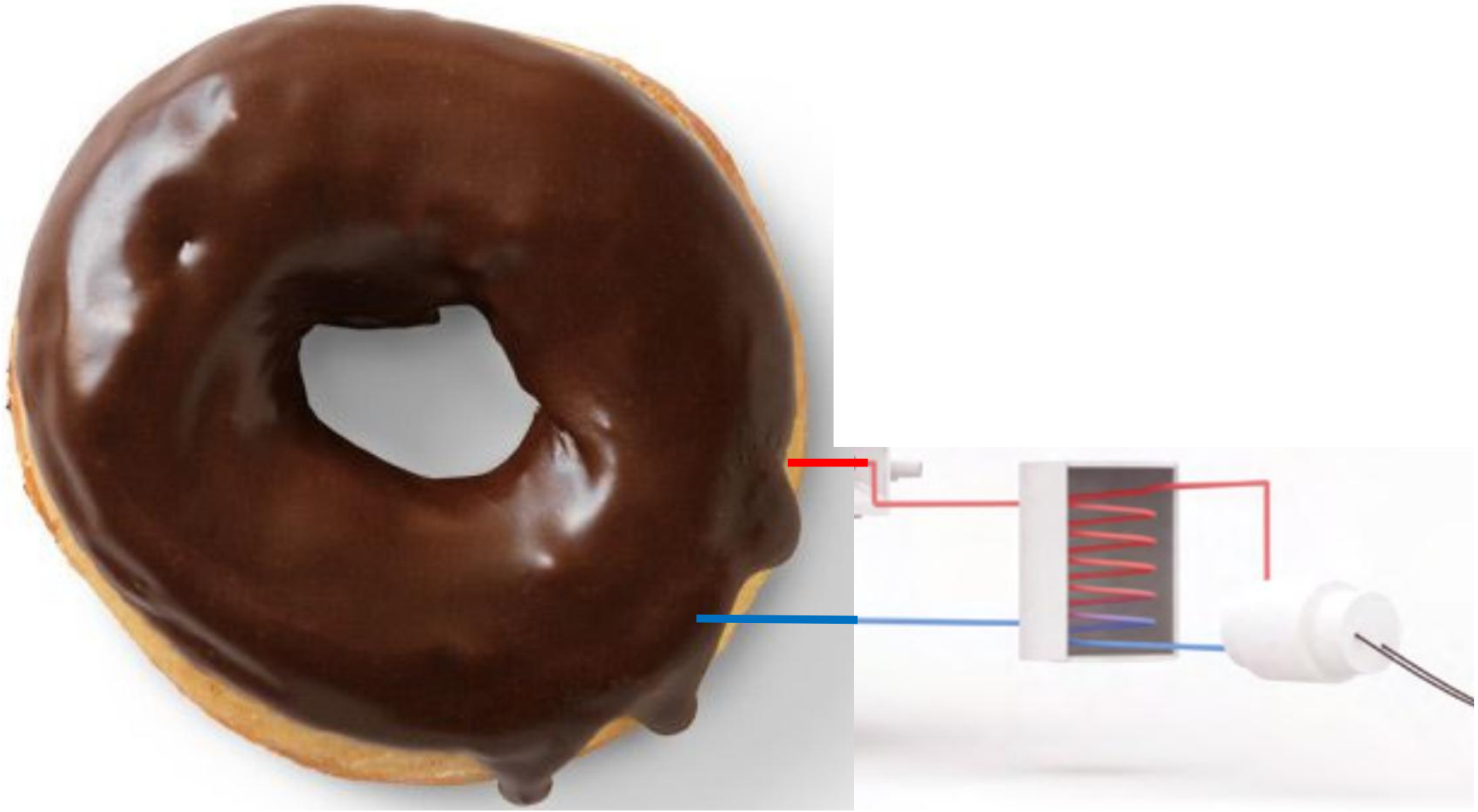
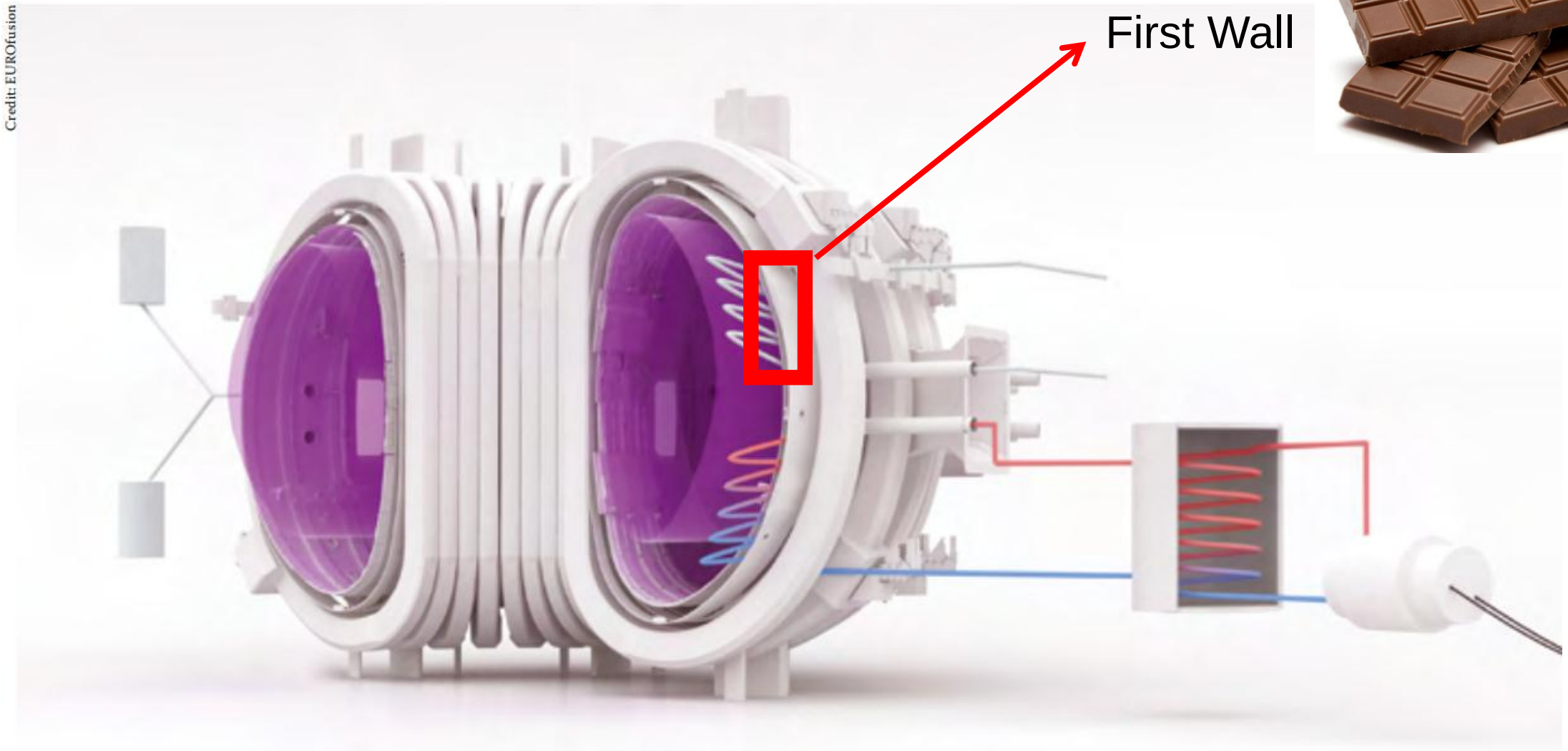
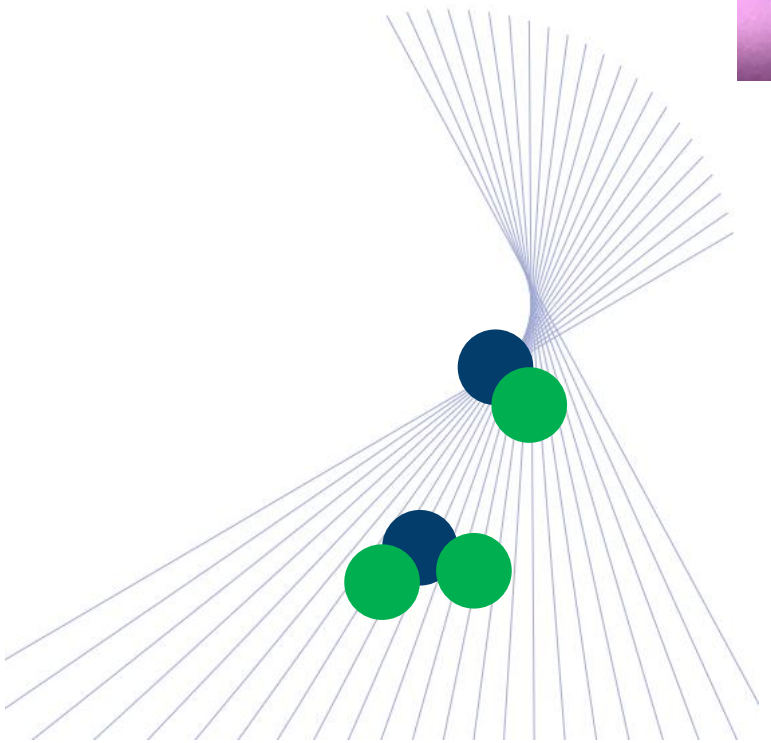


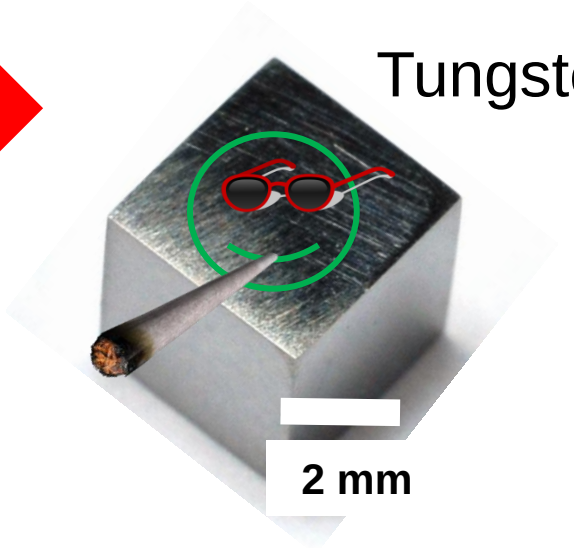

Credit: EUROfusion
First Wall



14.1 MeV

0.5 MW m^{-2}

Tungsten (W)

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Tungsten (W)

1273 K

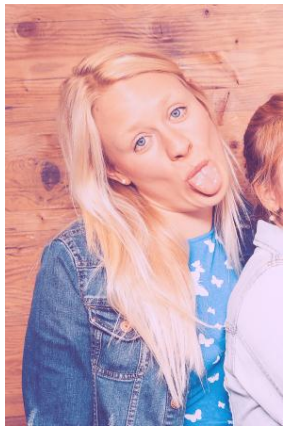
10 h, air

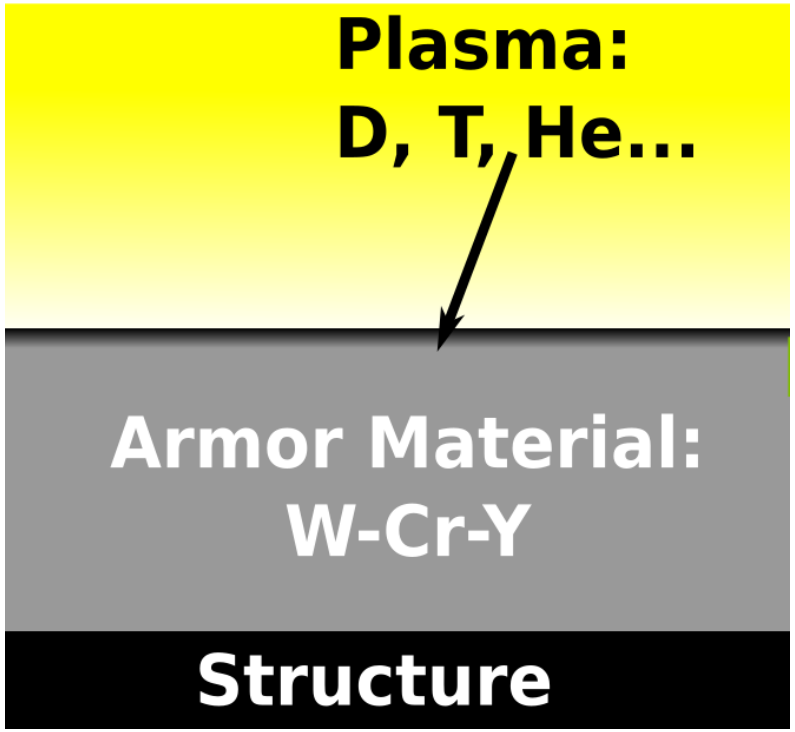
Tungsten oxide (WO_3)

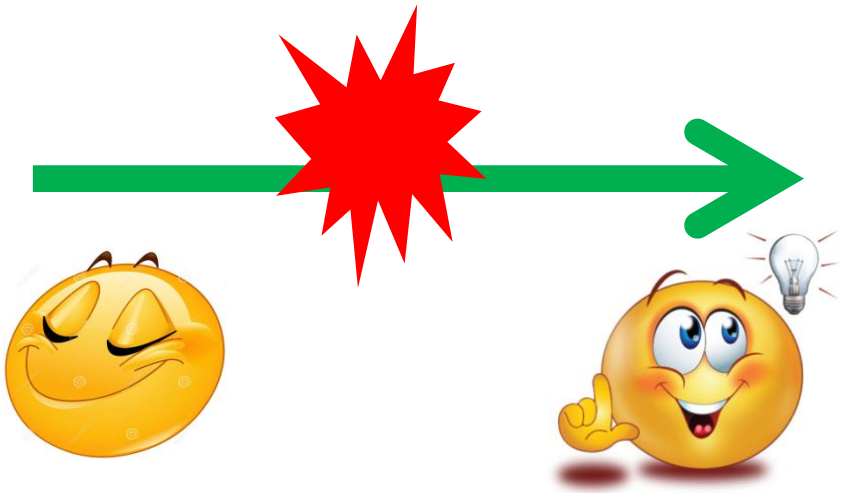
Plasma:
D, T, He...

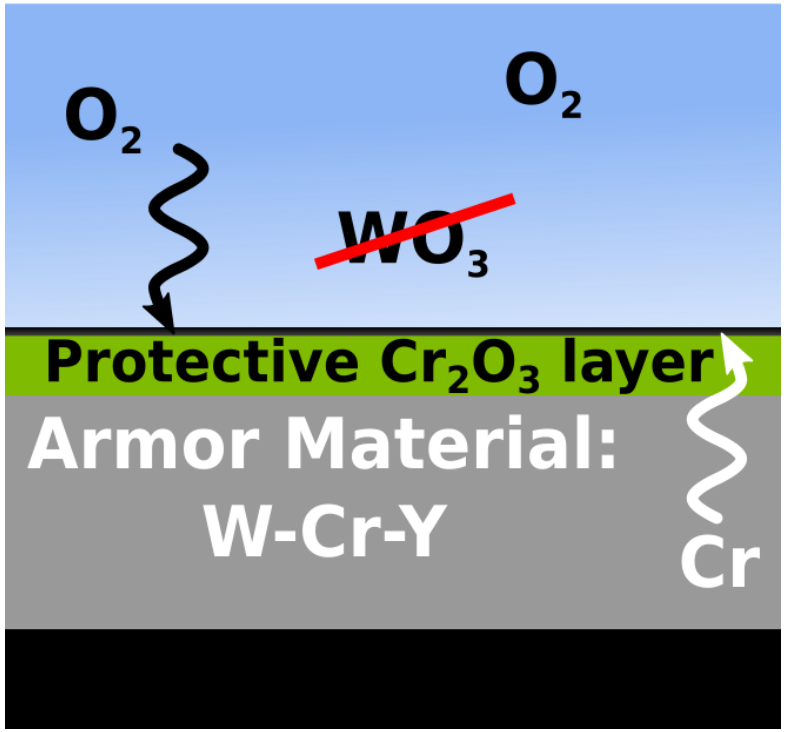
Armor Material:
W-Cr-Y

Structure




Plasma:
D, T, He...
Armor Material:
W-Cr-Y
Structure



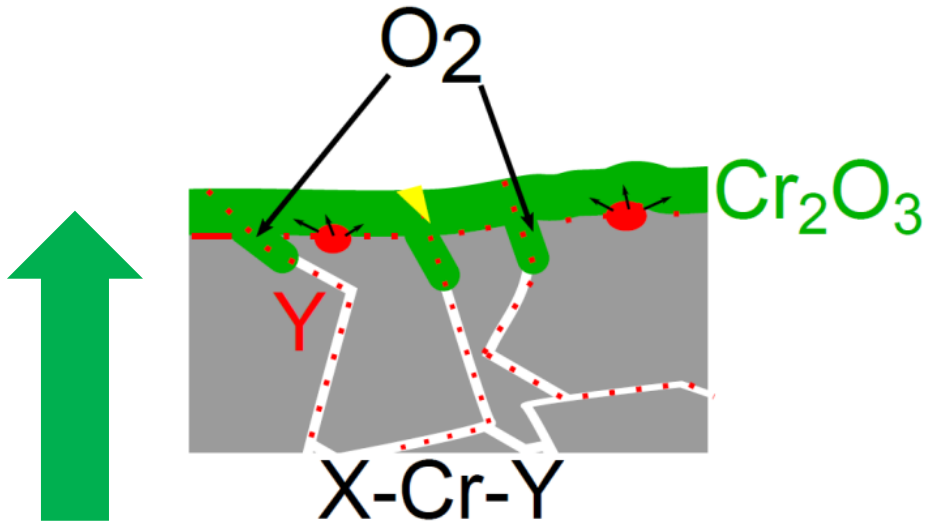

O_2
O_2
WO_3
Protective Cr_2O_3 layer
Armor Material:
W-Cr-Y
Cr

Tungsten (W), 88 %

Chromium (Cr), 11 %

Yttrium (Y), < 1 %

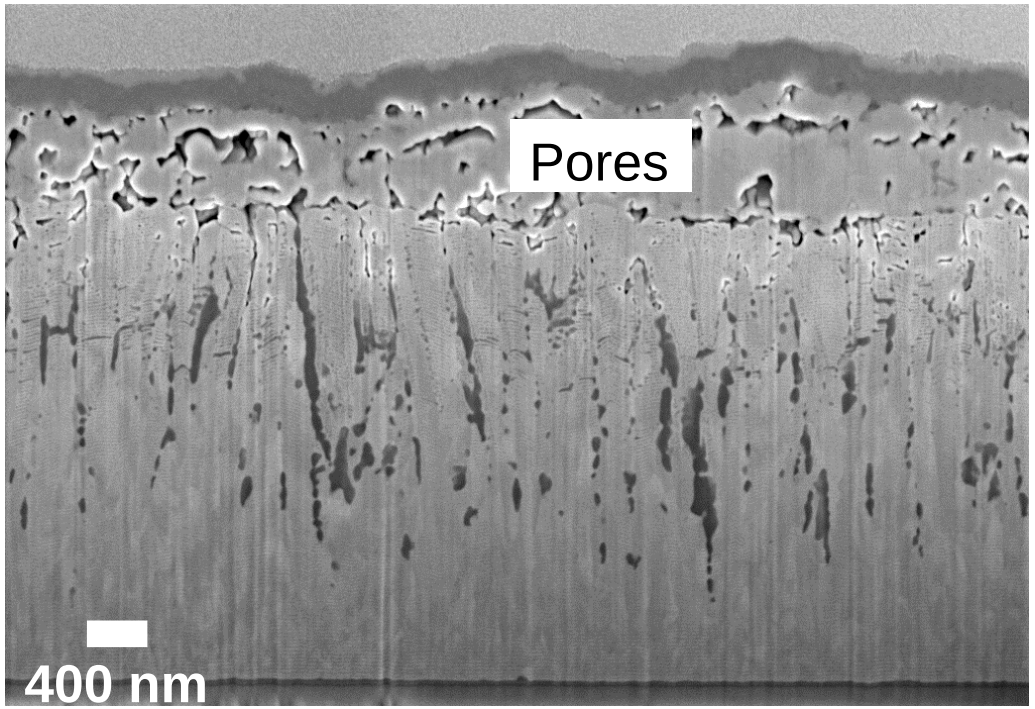
Chromium (Cr)

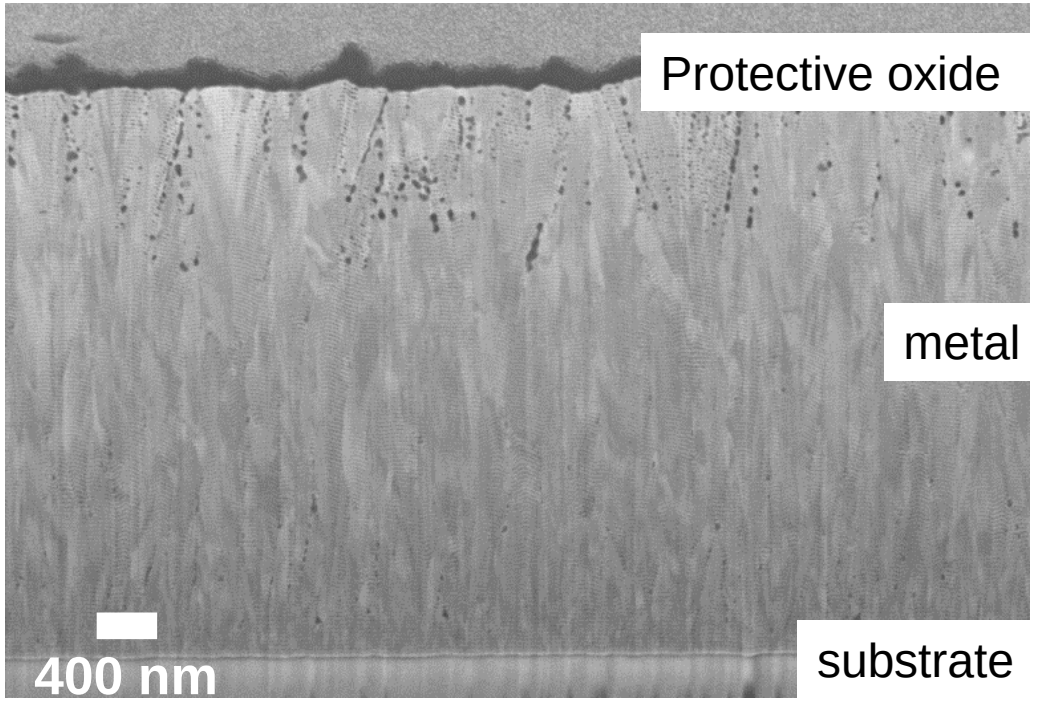


W-Cr

1273 K, ~ 0.2 h

W-Cr-Y





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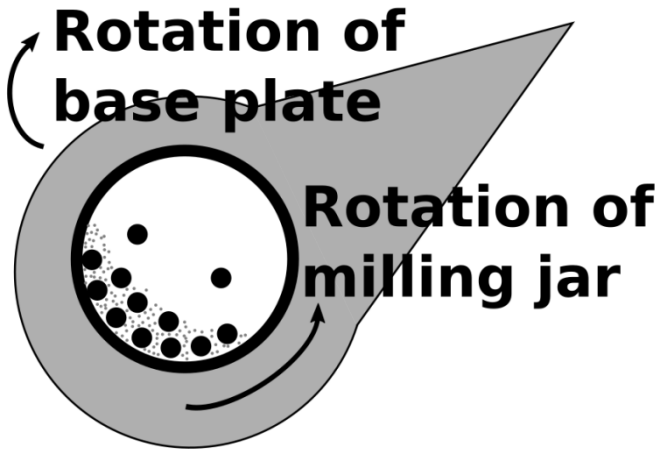
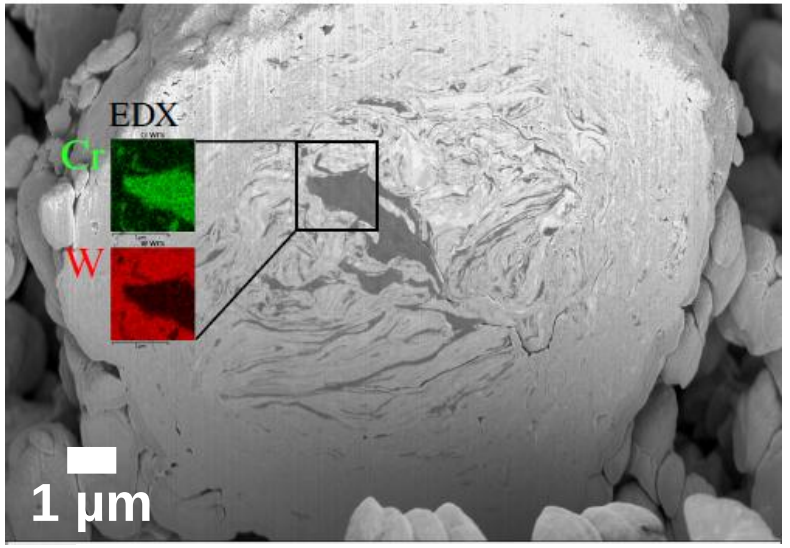
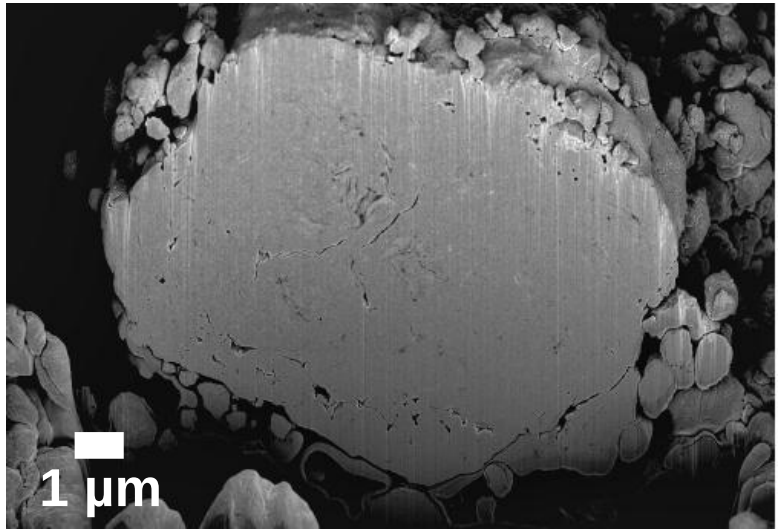

Rotation of
base plate
Rotation of
milling jar

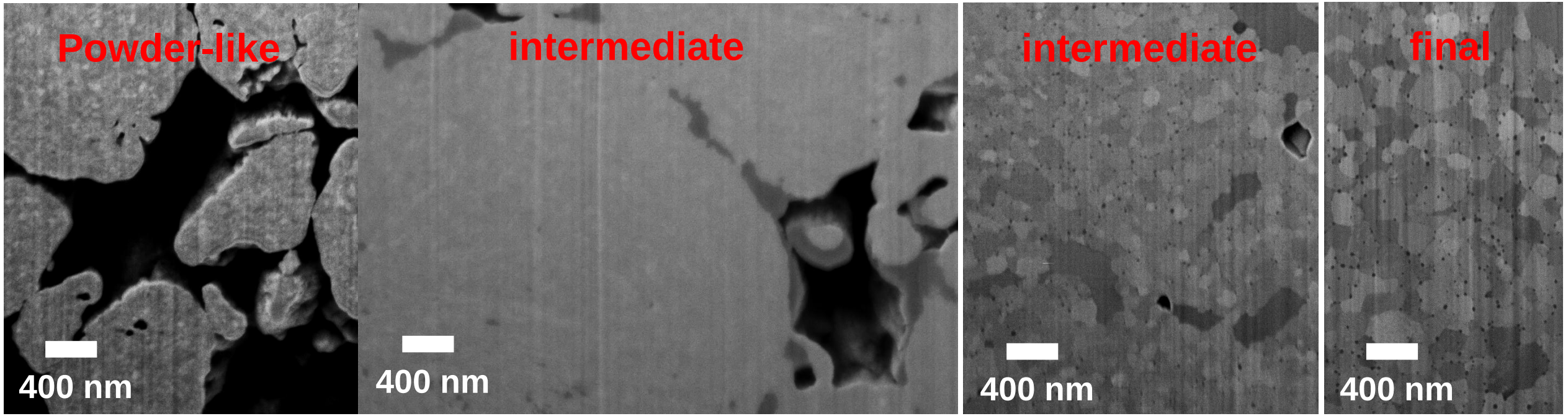

EDX
Cr
W
1 µm

40 h

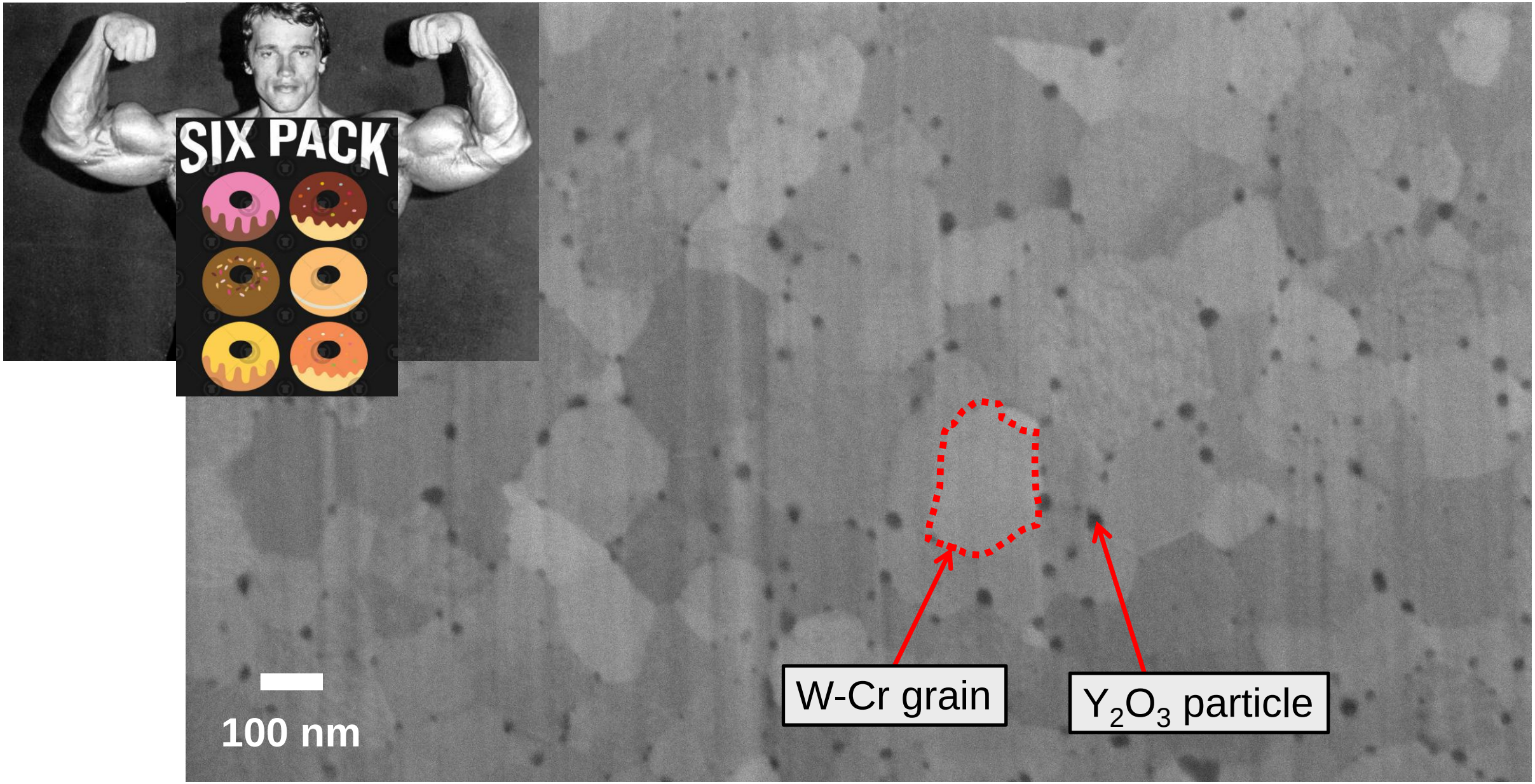

1 µm

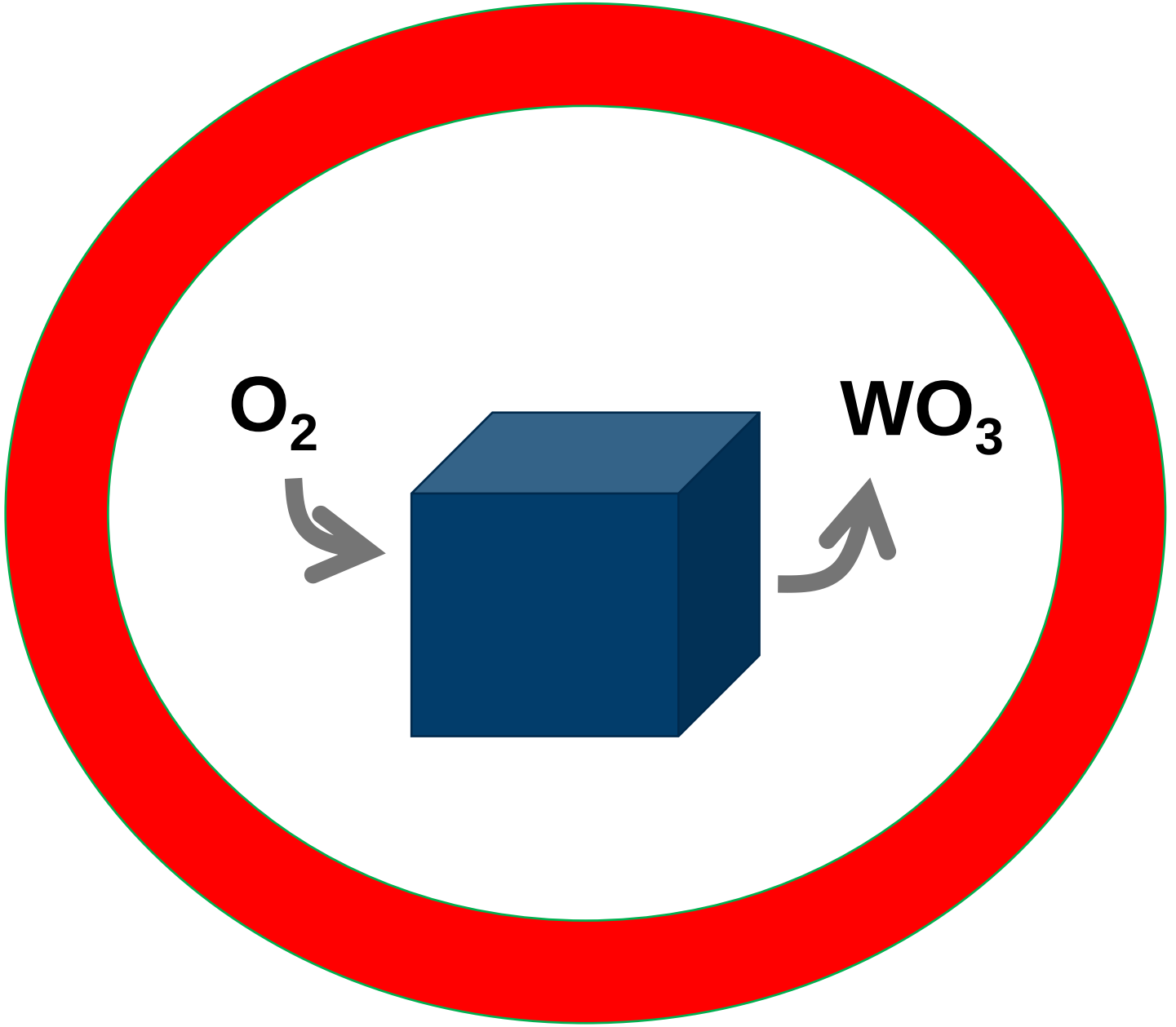
60 h

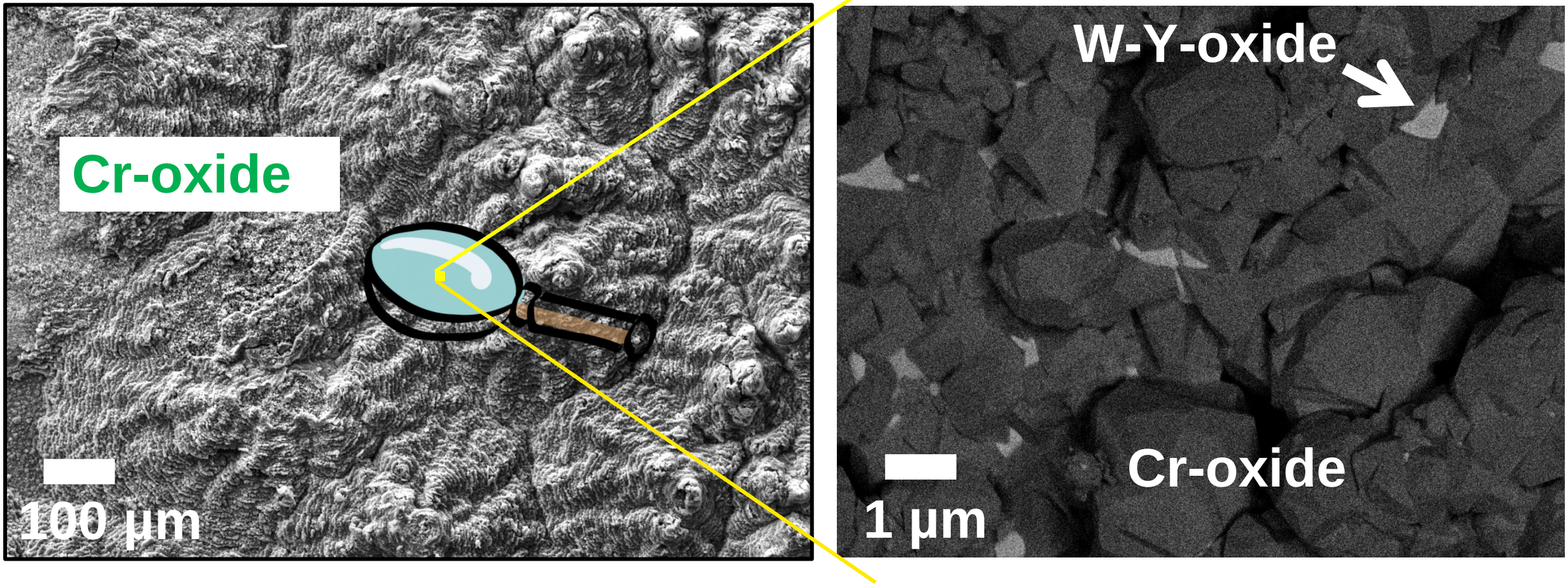
1279 K —51 s→ 1449 K —50 s→ 1614 K —38 s→ 1739 K



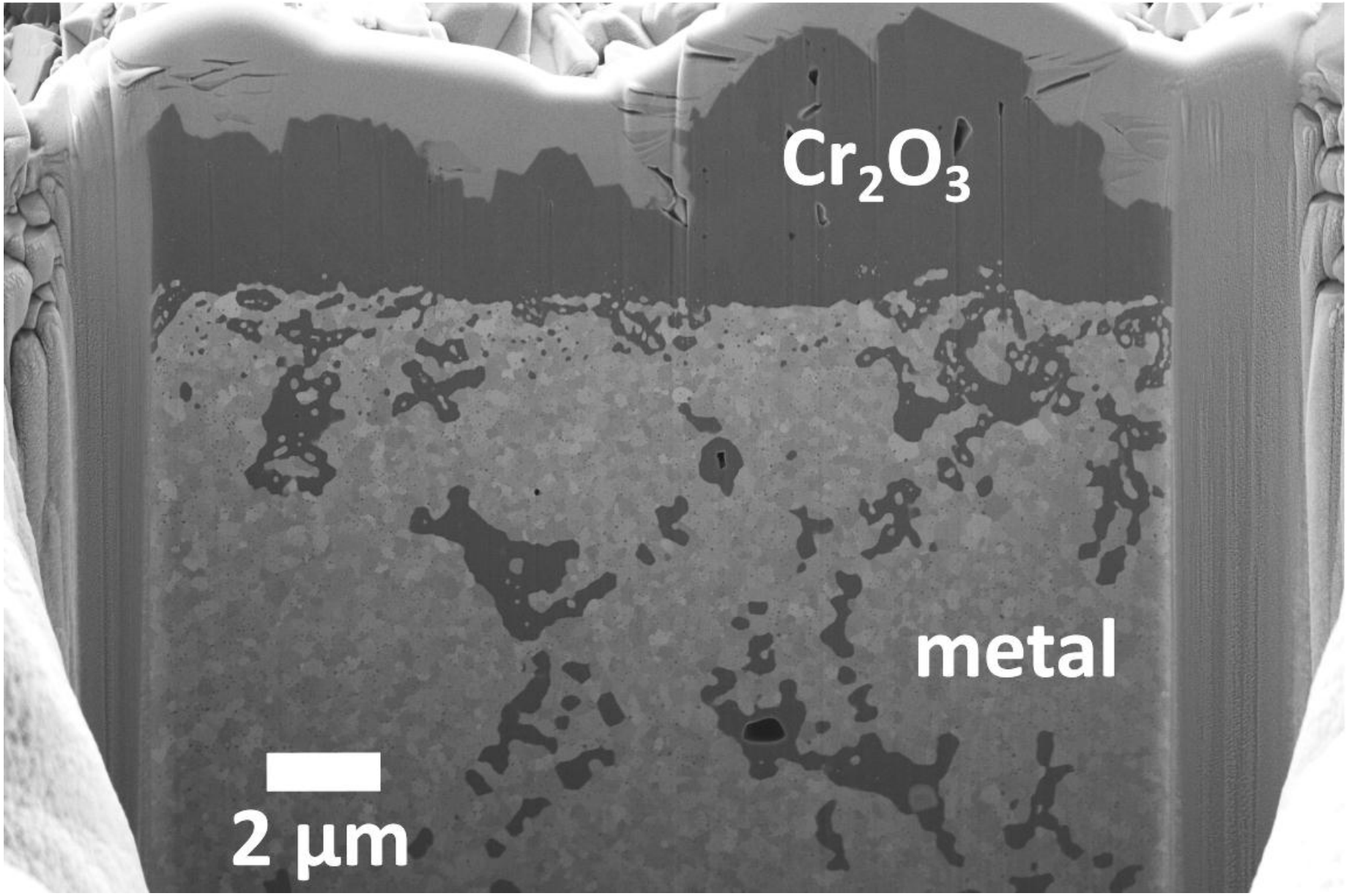
Relative density: ~ 70% ~ 80% 98 % 99 %


SIX PACK
100 nm
W-Cr grain
Y_2O_3 particle

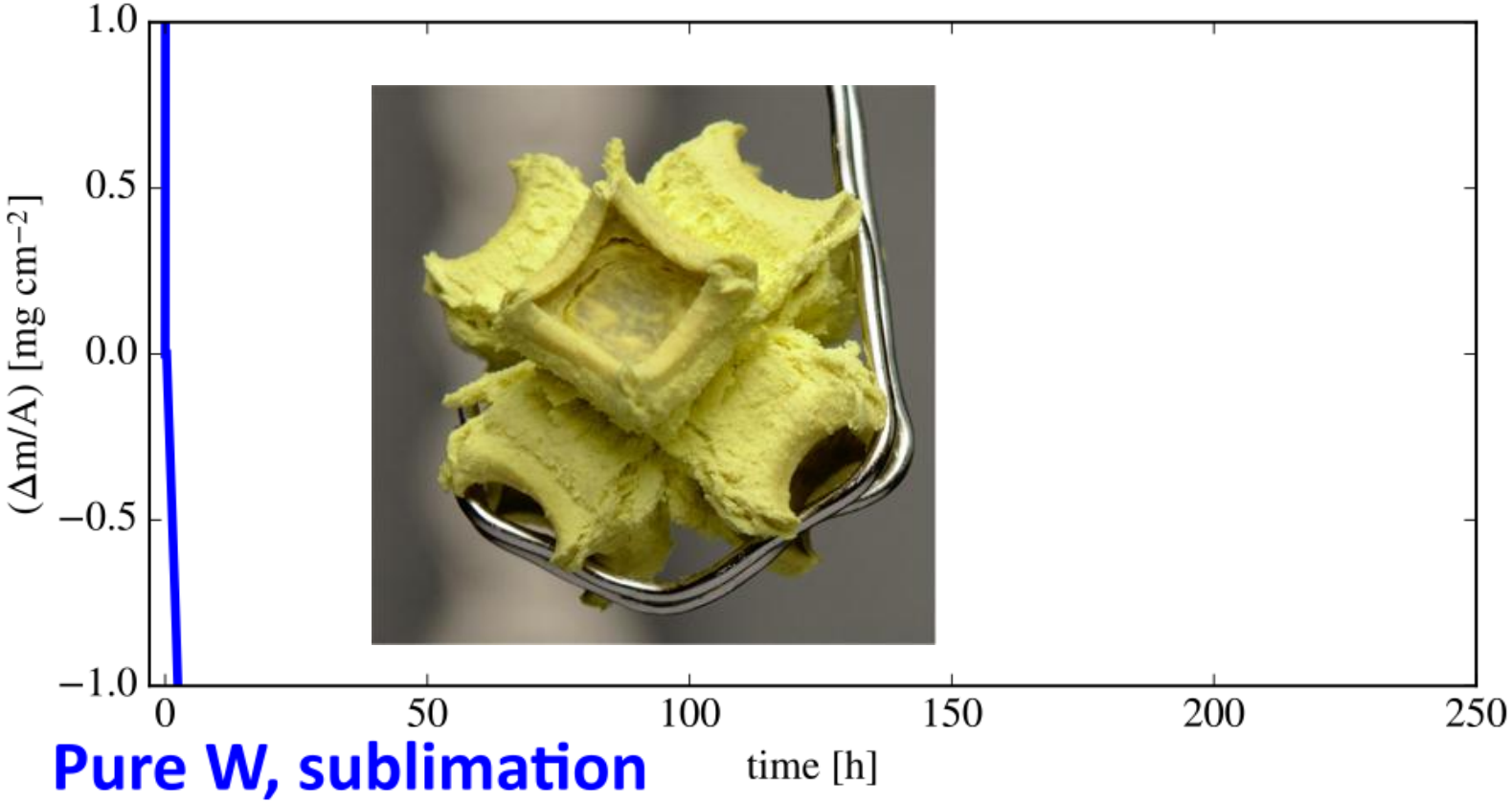

O_2
WO_3



10 days at 1273 K


Cr_2O_3
metal
2 µm

Pure W, total mass change



Pure W, sublimation

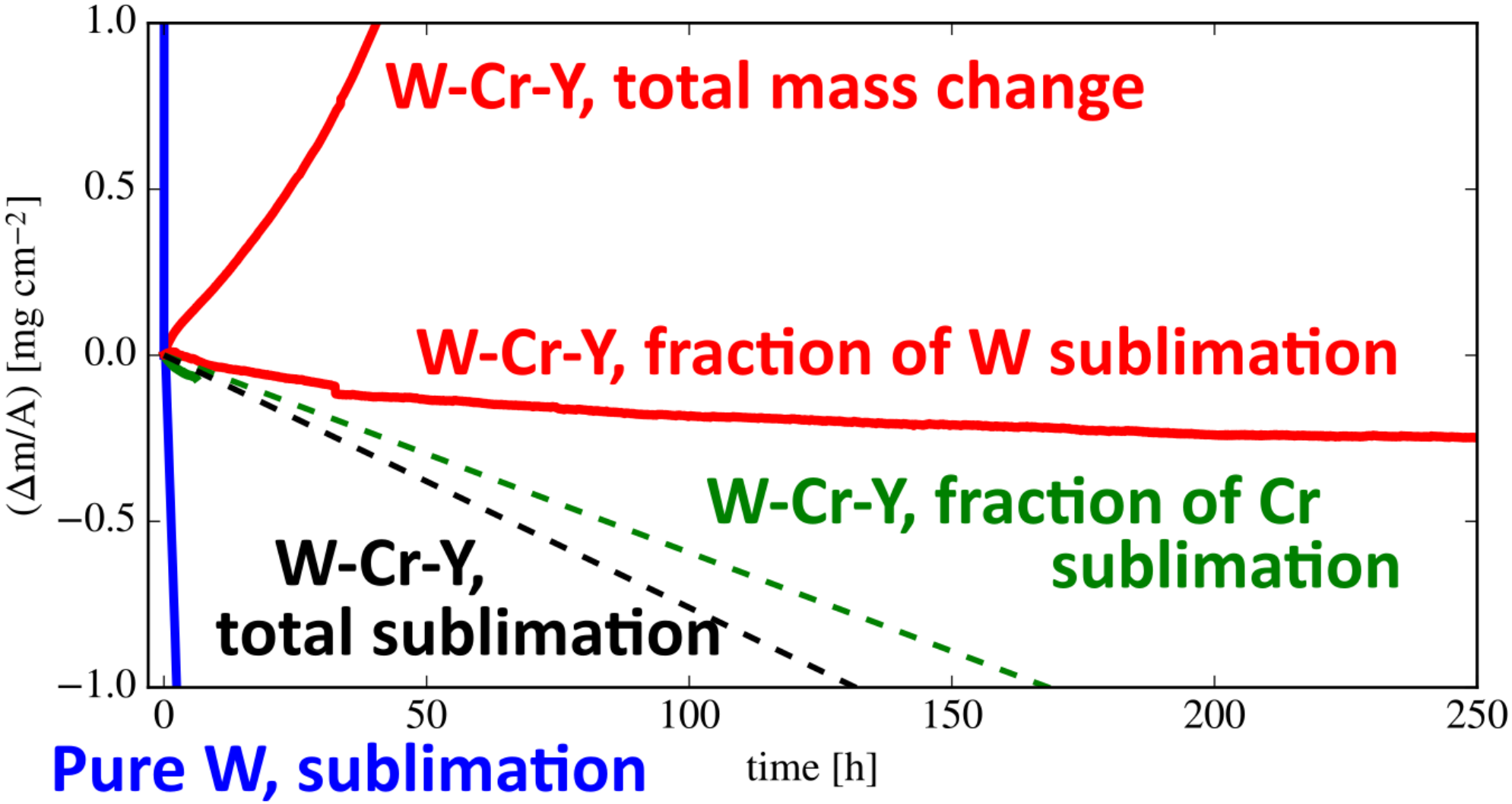
1273 K

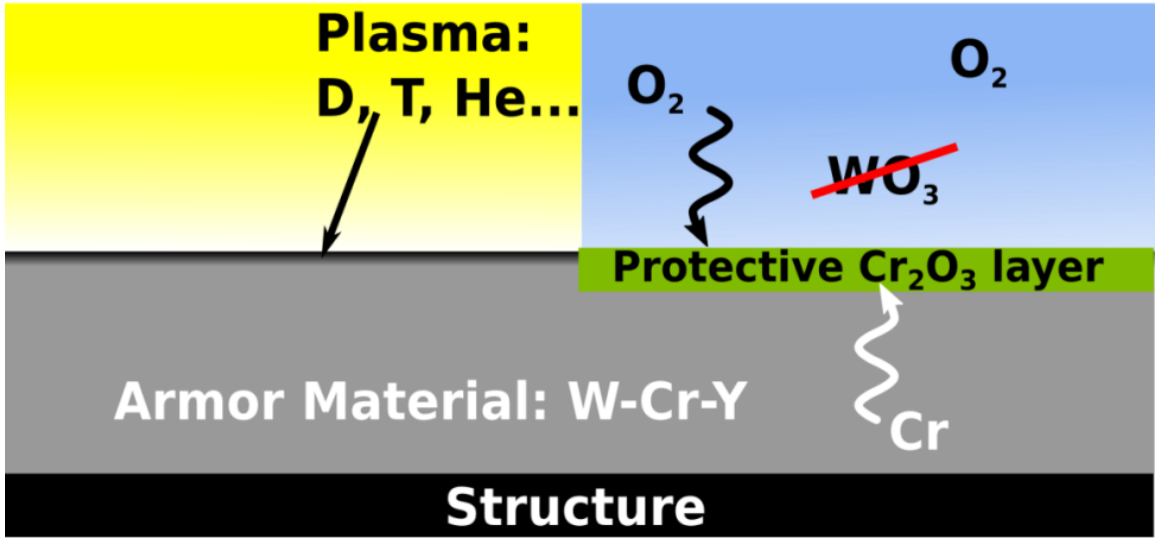
Pure W, total mass change

Pure W, total mass change

1273 K

33×

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O_2
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Cr
Structure