Pilot studies of industrial realization of SMART alloys for the first wall of DEMO

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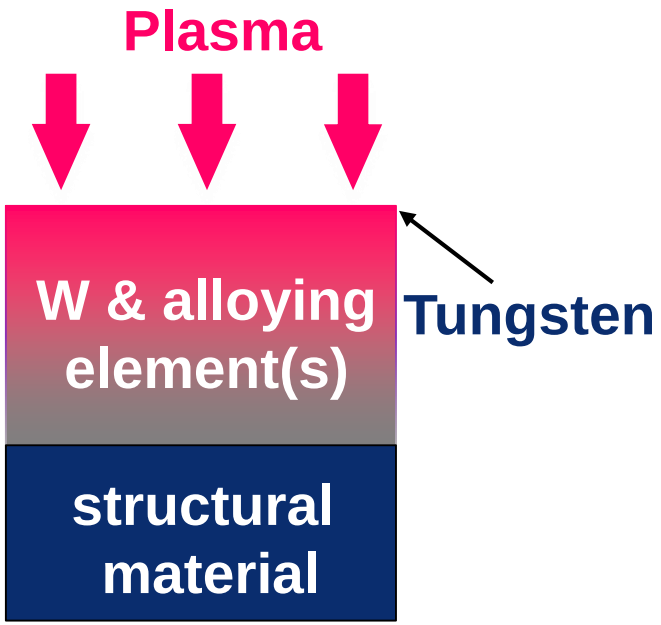
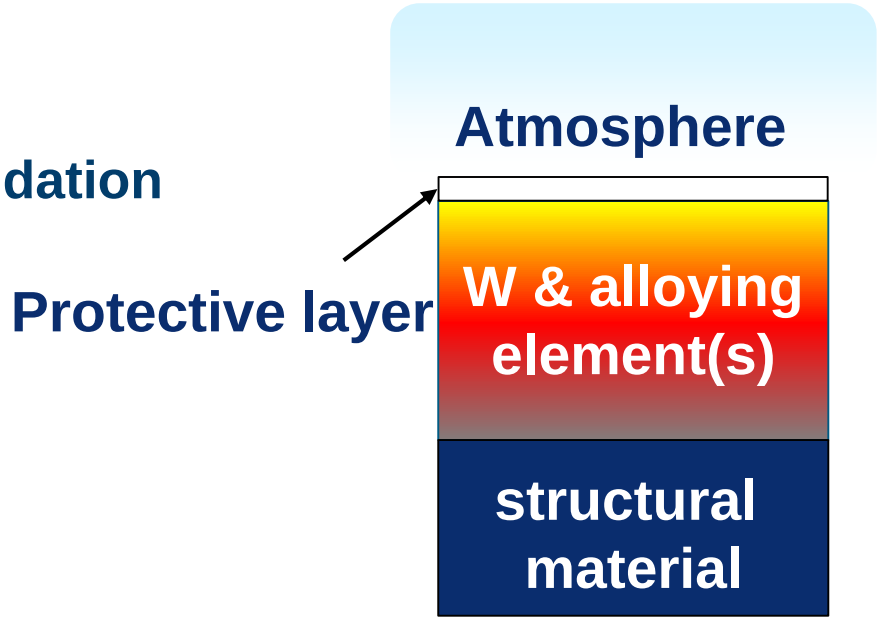
Safety during an accident in fusion power plant: SMART alloys

Regular operation[2] (730°C->550°C):
Tungsten surface via sputtering of alloying element(s) by plasma



Self-passivating
Metal
Alloys with
Reduced
Thermo-oxidation

Accident conditions:
(air ingress, up to 1200°C)
Formation of protective layer

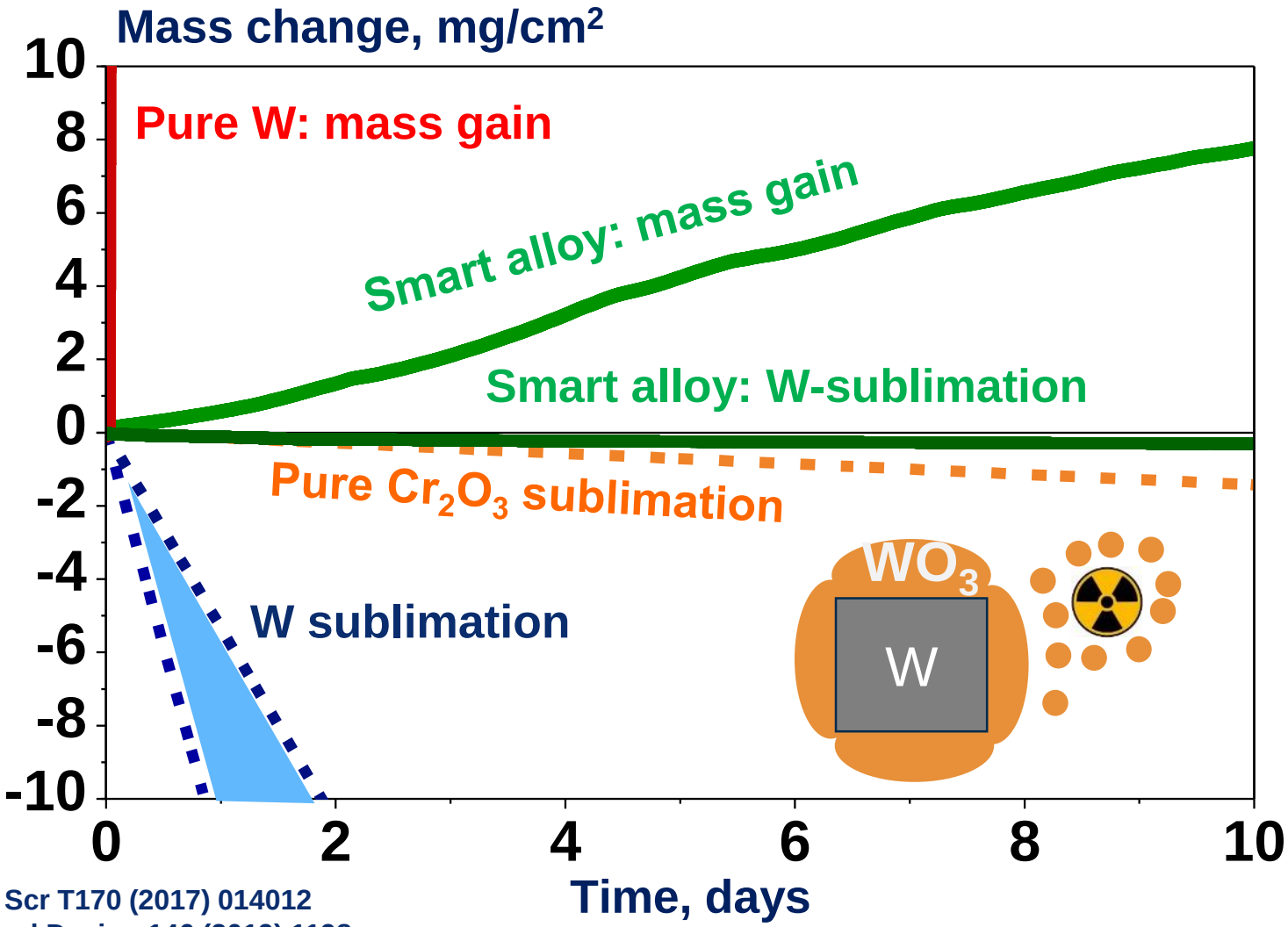


Behave like tungsten during plasma operation ← **SMART alloys** → **Suppress oxidation during accident[1]**

[1]F. Koch and H. Bolt, Phys. Scr. 128(2007)100

[2]Yu. Igitkhanov et al., Report-Nr. KIT-SR 7637.

Suppressed oxidation and sublimation[1,2]



[1]A. Litnovsky et al., Phys. Scr T170 (2017) 014012
[2]F. Klein et al., Fus. Eng. and Design 146 (2019) 1198

❖ > 40-fold suppression of W sublimation

SMART goes industry: Manufacturing of large samples[1]

Industrial Simoloyer ™
Mill at Zoz GmbH

SMART W-Cr-Y sample sintered at FZJ
using industrial Dr. Fritsch DSP 515 facility

- sample size: 10 cm×10 cm×0.7 cm
- sample mass: 760 g

SMART W-Cr-Zr sample sintered
in HFUT (China)

- sample size: 10 cm×10 cm×0.75 cm

- **First larges samples**
- **Using industrial powder**

- **Optimized sintering routine**
- **Industrial sintering facilities**

[1]**A. Litnovsky et al., Metals 11 (2021) 1255**

Summary and outlook

- Tungsten-based SMART alloys are under development for a fusion power plant
- Bulk SMART alloys produced via mechanical alloying and field-assisted sintering
- First steps of industrial up-scale made: mechanical alloying at industrial partner and sintering using industrial equipment
- Further optimization of mechanical alloying: zirconia tools and sintering using industrial powder

More details: Invited talk of Yury Gasparyan (377) and oral talk of Xiaoyue Tan (115)

Thank you

Questions?

Let's meet at Zoom:

Meeting: 894 5091 9648

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or