Ultra high oxidation resistance of nano-structured thin films

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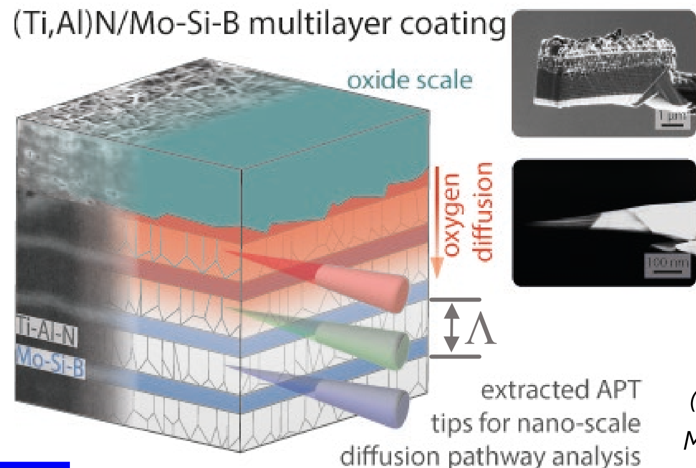
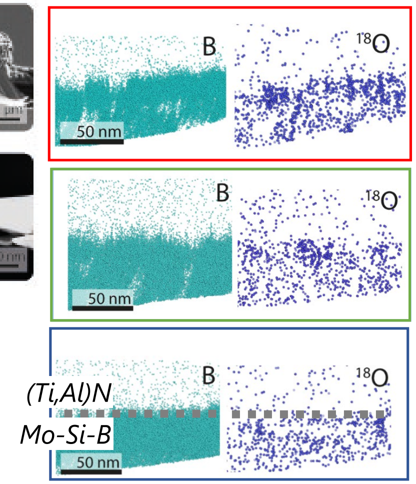
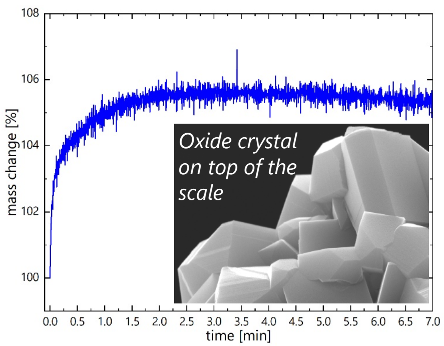
Oxidation of thin films at high temperatures

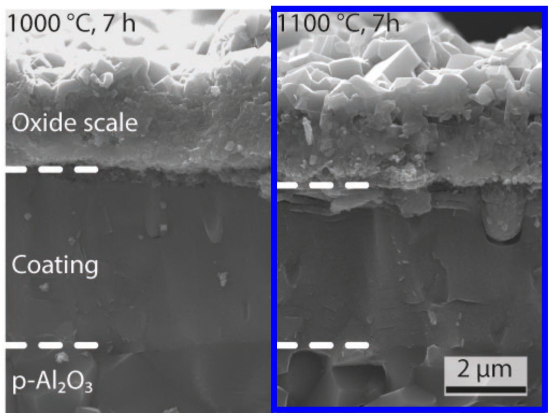
- **Oxidation is a diffusion driven process** of (i) oxygen through a formed scale or (ii) metal cations to the surface
- Enhanced oxidation resistance of fcc-(Ti,Al)N by incorporation of amorphous Mo-Si-B layers as oxygen diffusion barriers, forming a **nano-structured multilayer system**
- **Identification of diffusion pathways** in front of the actual scale by ^{18}O tracer diffusion, using *Atom Probe Tomography*







TG signal for the multilayer (Λ = 32 nm) oxidised @ 1100°C for 7h.



Results

- Oxygen diffusion front ahead of the visual oxide scale
- (Ti,Al)N is almost free of ^{18}O → **fast diffusion along crystal defects** such as grain and column boundaries
- Gained knowledge used to improve the existing multilayer system, achieving an excellent oxidation resistance at **1100 °C for 7 h**, with 4.3 µm remaining coating thickness out of 6 µm in the as-deposited state

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