

Development of $\text{Re}(\text{Al},\text{Si})_{1.8}$ Coating on Nb-Hf Alloy of Thruster Engines



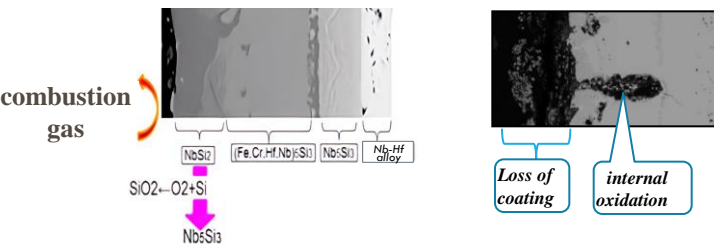
Satellite Thruster Engines:

- @ increasing in the combustion gas temperature
- @ Reducing fuel used for film cooling
- @ A variety of propellants

(NbSi_2) coating to form SiO_2

As-formed

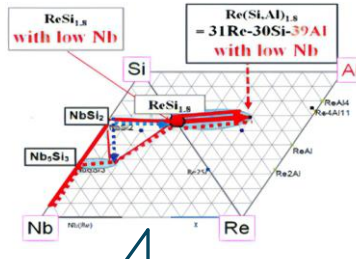
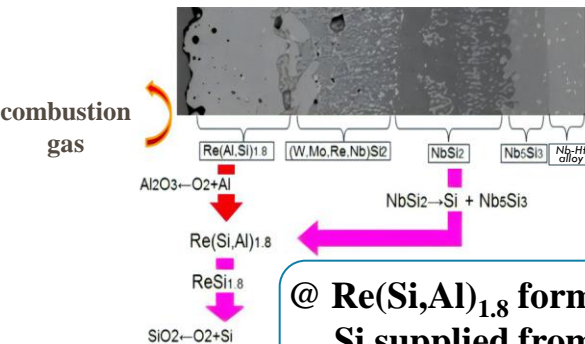
After oxidation at 1400°C



Issues:

- @ Operating temperature is lower than 1400°C
- @ NbSi_2 forms SiO_2 which is unstable in water vapor
- @ SiO_2 changed from glassy to crystallite, which accelerate cracks, resulting in rapid degradation of Nb-based alloys

$\text{Re}(\text{Al},\text{Si})_{1.8}$ coating to form Al_2O_3



- @ $\text{Re}(\text{Si},\text{Al})_{1.8}$ forms Al_2O_3 and it can maintain its structure by Si supplied from the inner NbSi_2 which changed into Nb_5Si_3
- @ Al_2O_3 is stable above 1500°C in both CO_2 and H_2O

Features :

- @ Simultaneous Formation of Alloy and Coating \Rightarrow Additive Manufacturing Process
- @ A variety of Fuels $\Rightarrow \text{CO}_2$ and H_2O
- @ Ultra-high Temperature \Rightarrow up to 1800°C and more



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