

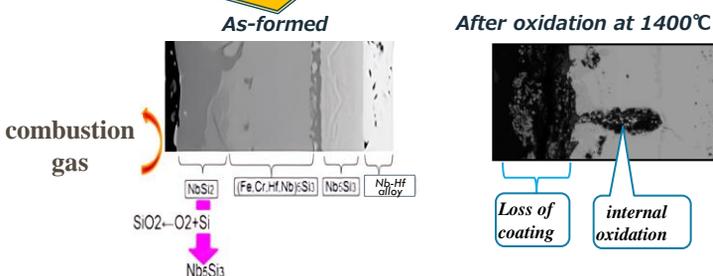
# Development of $\text{Re}(\text{Al},\text{Si})_{1.8}$ Coating on Nb-Hf Alloy of Thruster Engines



## Satellite Thruster Engines:

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

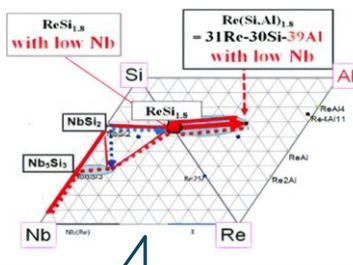
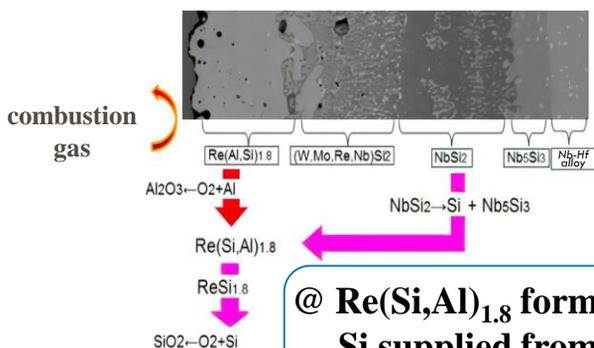
### $(\text{NbSi}_2)$ coating to form $\text{SiO}_2$



#### Issues:

- @ Operating temperature is lower than  $1400^\circ\text{C}$
- @  $\text{NbSi}_2$  forms  $\text{SiO}_2$  which is unstable in water vapor
- @  $\text{SiO}_2$  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 $\text{Al}_2\text{O}_3$



- @  $\text{Re}(\text{Si},\text{Al})_{1.8}$  forms  $\text{Al}_2\text{O}_3$  and it can maintain its structure by Si supplied from the inner  $\text{NbSi}_2$  which changed into  $\text{Nb}_5\text{Si}_3$
- @  $\text{Al}_2\text{O}_3$  is stable above  $1500^\circ\text{C}$  in both  $\text{CO}_2$  and  $\text{H}_2\text{O}$

#### Features :

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



**DBC System R&D, Co. Ltd.**

<Location > 1-515-3, Zenibako, Otaru-City Hokkaido, Japan

<TEL > +81-134-61-1670

<FAX > +81-134-61-1671

<URL > <http://dbcssystem.co.jp>

<e-mail > [dbc@dbcssystem.co.jp](mailto:dbc@dbcssystem.co.jp)

<President > Dr. Toshio Narita (Emeritus Professor, Hokkaido Univ.)