

## A Study on Oxidation Mechanism in Mechanically Alloyed ODS Ni-base Alloy

I.H Kim, S.I Kwun, J.P Park, \*W.S Lee

Division of Materials Science and Engineering, Korea University, Seoul 136-701, Korea.

\*Advanced Material R&D Center, Korea Institute of Industrial Technology, Chonan 330-825, Korea.

### Introduction

Commercial ODS(Oxide Dispersion Strengthened) Ni-base alloys are developed for high temperature structural application. This alloy is strengthened by a uniform dispersion of sub-micron size  $Y_2O_3$  particle in a matrix. It is known that the Cr enriched ODS alloy shows excellent oxidation resistance by formation of dense Cr oxides at the surface preventing subsequent oxidation.

Many researchers have studied to find the reason for superior oxidation resistance in ODS Ni-base alloy but they did not refer to the oxide growth mechanism. This study aimed to find out the oxide growth mechanism in general ODS alloy through oxidation tests of mechanically alloyed Ni-20Cr-20Fe-5Nb-1Y<sub>2</sub>O<sub>3</sub> alloy and commercial PM1000 alloy.

### Experimental details

The Ni-20Cr-20Fe-5Nb-1Y<sub>2</sub>O<sub>3</sub>, Ni-20Cr-20Fe-5Nb and commercial PM1000 alloys used in the present study were oxidized at 1000°C for 100 hours to evaluate oxidation resistance. XRD measurement and SEM, TEM observations were performed to find out the kinds of oxide compounds. Weight gains were measured every 20 hours to compare the degree of oxidation of three alloys. A oxide growth mechanism is suggested through microstructural evaluation before and after oxidation in ODS alloy.

### Results and Discussion

The oxidation resistance of Ni-20Cr-20Fe-5Nb-1Y<sub>2</sub>O<sub>3</sub> and PM1000 was superior to that of Ni-20Cr-20Fe-Nb alloy without Y<sub>2</sub>O<sub>3</sub>.

Judging from the shape and size of continuously growing oxides in Ni-20Cr-20Fe-5Nb-1Y<sub>2</sub>O<sub>3</sub> alloy, the oxides in this alloy were formed at particle boundaries and their appearance was similar to the oxides in commercial PM1000 and MA754 alloy.

Through SEM observation of the alloy, it could be confirmed that much Cr carbides were already formed at particle boundaries before oxidation. It is believed that the Cr denuded zone is formed around of these carbides. Therefore, when this alloy is oxidized at 1000°C, Cr in the matrix might diffuse toward particle boundary due to Cr concentration gradient between matrix and Cr denuded zone near boundary. It is

thought that Cr oxide grow continuously by reacting the Cr supplied from the matrix with oxygen at particle boundary.

### **Summary**

1. The oxidation resistance of  $Y_2O_3$  containing Ni-base alloy is superior to that of the alloy without  $Y_2O_3$ .
2. The appearance of oxides of Ni-20Cr-20Fe-5Nb-1 $Y_2O_3$  alloy is similar to that of oxides in commercial PM1000 and MA754 alloy.
3. The oxides in ODS alloy are grown mainly at particle boundaries.