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Preparation of Cyclic Oxidation Resistant Coating Consisting of Ni Aluminide and Ni-Hf Alloy Layers on Ni-Cr-Al Alloy by Electrodeposition

Shota UCHIDA*, Naka SATO**, Michihisa FUKUMOTO** and Motoi HARA**

* Graduate School of Engineering Science, Akita University, Akita 010-8502, Japan
** Department of Materials Science, Graduate School of Engineering Science, Akita University, Akita, Japan 010-8502, Japan
E-mail : haramoto@gipc.akita-u.ac.jp

The preparation of a coating consisting of a Ni aluminide layer and Ni-Hf alloy layer on a Ni-Cr-Al alloy was attempted by the four-step electrodeposition of Ni, Hf, Ni and Al. In this study, the Ni electrodeposition was carried out using an aqueous solution, while the Hf and Al electrodepositions were carried out using a molten salt at 1023 K. The cyclic oxidation resistance for the alloy covered with the coting was then evaluated in air at 1373 K. This estimation was carried out by comparison of the alloy covered with a single Ni aluminide layer. For the alloy covered with the single Ni aluminide layer, a decrease in the mass gain of the alloy due to scale spalling was observed, while for the alloy covered with the bilayer coating, such a decrease was not observed. It was found from the observation of a cross-section of the alloy covered with the single Ni aluminide layer that the Al concentration in the surface region of the Ni aluminide layer decreased due to the diffusion of Al from the Ni aluminide layer to the substrate alloy. On the other hand, for the alloy covered with the bilayer coating, the diffusion of Al from the Ni aluminide layer to the substrate alloy was inhibited by the diffusion barrier effect of the Ni-Hf alloy layer. After the 10-cycle oxidation, the decomposition of the Ni-Hf alloy layer proceeded, and as a result, Hf in the Ni-Hf alloy layer diffused into the surface region of the Ni aluminide layer. The Hf in the surface region of the Ni aluminide layer led to the formation of an adhesive scale having a spiked shape.

Keywords : Electrodeposition, Molten salt, Coating, Oxidation resistance, Nickel aluminide, Nickel-hafnium alloy