High temperature oxidation behavior of CrAl alloy layer coated Zr fuel cladding using arc ion plating

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Zirconium based alloy have been generally used for nuclear fuel cladding due to their fairly good resistance to corrosion from water at elevated temperatures and a very low absorption cross-section of thermal neutrons. After Fukushima nuclear reactor accident, however, the development of new concept of fuel cladding is required because the aggressive oxidation and significant heat production of existing zirconium-based alloys in a high-temperature steam environment could significantly increase the risk of explosion caused by hydrogen gas. In this study, we aim to develop surface coated zirconium cladding with CrAl alloy to enhance safety of nuclear reactor during accident. We found that CrAl alloy has an excellent oxidation resistance at high temperature. For CrAl alloy layer coating, arc ion plating technique was used. To investigate efficiency of the CrAl alloy coating to act as oxidation resistant barrier, high temperature oxidation test as well as metallurgical investigation were carried out. CrAl coated zirconium-based alloy oxidized at 1200°C in a steam environment showed much lower weight gain compared to bare zirconium-based alloy samples. The microstructure of the oxide layers formed on coated zirconium tubes during high temperature oxidation test is characterized systematically by using various analyzing tools.