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Characteristic of Oxidation Resistant High-Entropy Alloys (HEA) for Application in Zero-Emission Technologies

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Abstract : A constant requirement to reduce greenhouse gas emissions, in combination with the desire to increase gas turbine efficiency, results in a continuous trend to increase the operating temperature of gas turbines. An increase in operating temperature will result in lower fuel consumption, and a higher combustion temperature will result in lower pollution release. Moreover, there is a strong trend for hydrogen to be used as an alternative and clean fuel. However, using hydrogen or hydrogen-rich fuel results in a higher combustion temperature, as well as an increase in the water vapor content in the exhaust gases. Commonly used Ni-base alloys have their limits. Moreover, the presence of water vapor worsens the oxidation behavior of Ni-based alloys at a high temperature. Therefore, a material is demanded to be used in gas turbines operated with hydrogen-rich fuel. High-entropy alloys (HEAs) seem to be very promising materials to replace commonly used Ni-based alloys. HEAs are a group of materials consisting of at least five main equiatomic elements. These alloys can be doped by other elements in amounts less than 5 at. % in total. Thus, in the present study, NiCoCrAlFe-X alloys are studied in terms of oxidation behavior during exposure to dry and wet atmospheres. NiCoCrAlFe-X alloys are doped with minor alloying elements in amounts ranging from 1-5 at.%. The effect of the chemical composition on oxidation resistance in dry and wet atmospheres will be shown and discussed.

Keywords : high entropy alloys, oxidation resistance, hydrogen fuel, water vapor
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