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Oxidation behavior of Inconel 718 at high temperatures in CO_2-rich atmospheres

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Introduction

Inconel 718 is a nickel-based superalloy widely used in high-temperature applications due to its excellent mechanical properties and resistance to high-temperature degradation. Its protective behavior is mainly associated with the formation of chromium-rich oxide scales, particularly Cr_2O_3.

However, exposure to high-temperature CO_2-rich atmospheres may affect reaction kinetics and oxide scale stability. Understanding these effects is essential to evaluate the performance and degradation mechanisms of Inconel 718 in industrial environments.

Goals

To investigate the high-temperature behavior of Inconel 718 in a CO_2 atmosphere at 900 °C for 100 h, evaluating its reaction kinetics and oxide scale characteristics.

Materials and Methods

Commercial Inconel 718 samples were exposed to a CO_2 atmosphere at 900 °C for 100 h in a conventional tubular furnace under a flow rate of 10 L/h. The experimental setup is illustrated in Figure 1. Mass variation was determined from initial and final sample weights. Post-exposure characterization was performed using SEM/EDS and XRD techniques.

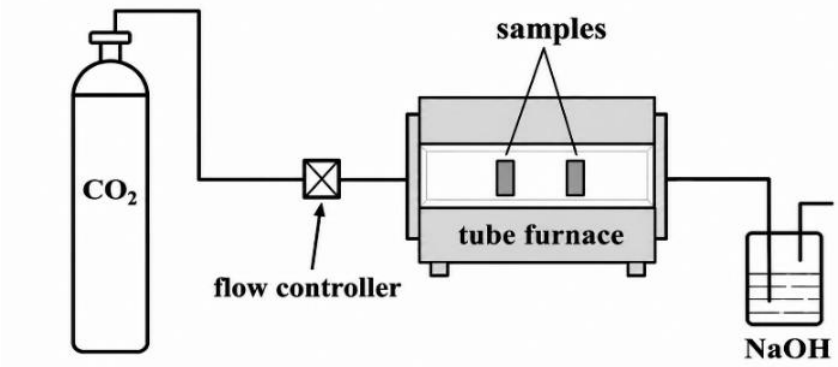


Figure 1: Schematic view of the experimental setup.

Results and Discussions

Figure 2 shows the average mass variation by surface area of Inconel 718 after the test.

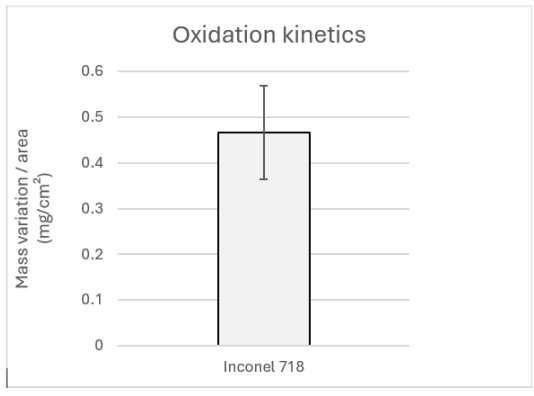


Figure 2: Mass variation by surface area after high temperature test.

SEM/EDS mapping (Figure 3) revealed Cr and Mn enrichment in the oxidized region, besides presence of Ti, Al and Nb close to the metal/oxide interface.

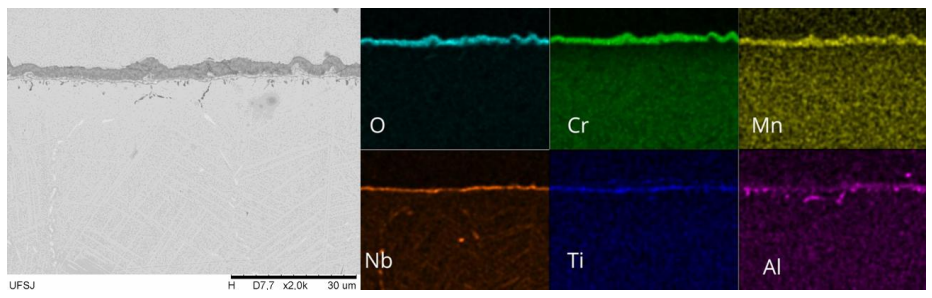


Figure 3: Sample cross-section observed by SEM/EDS.

Figure 4 presents the XRD pattern and the oxide phases identified, Cr2O3, MnCr2O4, TiO2 and Al2O3.

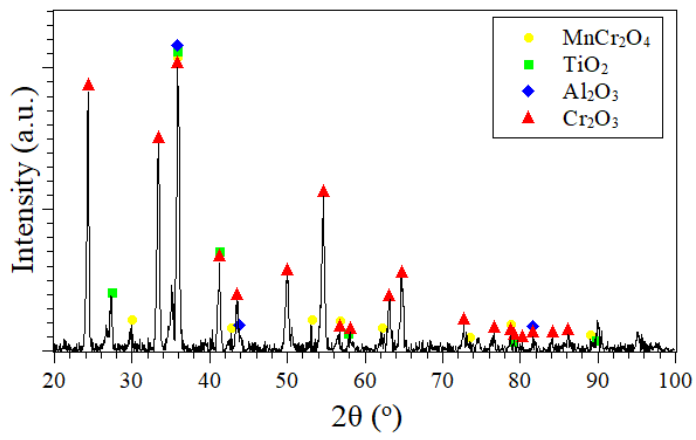


Figure 4: X-ray diffraction (XRD) after test at 900 °C/100 h.

Conclusions

High-temperature test oxidation of Inconel 718 at 900 °C for 100 h in CO_2 resulted in mass gain and oxide formation.

EDS revealed Cr and Mn enrichment, while XRD indicated peaks consistent with Cr_2O_3, TiO_2, $MnCr_2O_4$ and possible Al_2O_3.

These findings highlight chromium's role in Inconel 718 oxidation.

References and acknowledgements

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