

Role of alloyed niobium on the isothermal oxidation of Fe-40Ni-24Cr alloy

Abstract

Fe-40Ni-24Cr alloy is the heat-resistant alloy usually used at high temperature service. The alloying elements normally added to the alloy to enhance the resistance to severe oxidation during service. The Fe-40Ni-24Cr alloy was experienced a high temperature oxidation at 700 °C for 500 h exposure time in laboratory air. The discontinuous isothermal oxidation test was carried out at different time intervals to record the weight change of the oxidized alloy throughout the experiment. The oxidized Fe-40Ni-24Cr alloy was characterized in terms of oxidation kinetics, phase analysis by using x-ray diffraction (XRD) technique and oxide surface morphology determination by using scanning electron microscope (SEM) equipped with energy dispersive x-ray (EDX) spectrometer. The oxidation kinetics of oxidized Fe-40Ni-24Cr alloy was exhibited a weight gain trend. The calculation of oxidation rate law was proved that this oxidized Fe-40Ni-24Cr alloy was obeyed parabolic rate law indicating the growth of oxide scales was followed a diffusion-controlled mechanism. The phase analysis of the oxidized Fe-40Ni-24Cr alloy recorded the formation of several oxide phases consists of Cr-rich, Fe-rich, Ti-rich, Nb-rich and spinel oxides structure. These oxides were served as a protective barrier between base metal and environment. The surface morphology of oxide scale after different exposure displayed a continuous oxide layer formed on the alloy surface with evidence of overgrown Nb-rich oxide particle at discrete area on the alloy surface starting from 150 h exposure time.

Keywords

Alloying elements; Fe-40Ni-24Cr alloy; HAYNES® HR-120® alloy; Isothermal oxidation; Ni-based alloys