ABSTRACT

Fe-Cr model alloys (Cr: 9, 17, and 25 wt %) were subjected to cyclic oxidation in Ar-20O2, Ar-20O2-5H2O and Ar-10H2-5H2O (pO2= 3.6 x 10-22 atm) all in volume % atmospheres at 700oC. In general, increasing alloy chromium levels reduced the oxidation rate. At high pO2, in the absence of water vapour, the 9%Cr alloy exhibited breakaway oxidation at the early stage of the reaction. However, for chromium levels ≥ 17%, no breakaway oxidation occurred, and the weight gain was very low. Adding water vapour to Ar-20O2 accelerated the oxidation of alloys containing ≤17% Cr. However, this accelerating effect was not evident for Fe25Cr alloy. At low pO2, breakaway oxidation of alloys with chromium concentration ≤ 17% occurred after 300 cycles. Fe25Cr alloy did not undergo significant oxidation. XRD and metallographic analyses showed that for Fe25Cr alloy, only thin Cr2O3 layer was formed. However, for other low chromium content, hematite, magnetite and spinel were also detected in the form of different layers in the thick oxide scale. An internal oxide zone with spinel was also formed for these low Cr alloys. The synergistic effects of water vapour and temperature cycling are discussed in terms of alloy chromium depletion and the affects of the H2O(g) on oxide transport properties.

Keywords: Fe-Cr alloys, water vapour, breakaway oxidation, internal oxidation, Cr2O3