Influences of the Base Element, the Oxide Scale Thickness and the Cooling Start Temperature on the Oxide Spallation of Cast Alloys during the Post-Isothermal Oxidation Cooling

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In this study it first appeared that, for such (M-25wt.%Cr) based cast alloys, that the base element is of importance since – beside its possible mismatch of thermal expansion behaviour with the external oxide – it strongly influences the nature of the scale: mainly chromia for Ni alloys, presence of additional CoO and CoCr2O4 for Co alloys, (Fe,Cr)2O3 for Fe alloys,... But another important parameter is the quantity of oxide formed (during heating - mainly isothermally), which increases with the temperature stage but also with the complex nature of the oxides formed (thicker scales if presence of CoO and CoCr2O4 oxides resulting of the faster oxidation of the Co-based alloys). The presence of hafnium, here in great quantities for promoting the formation of HfC carbides, played its usual beneficial role for the resistance against spallation.

Among the alloys studied here, the best resistant against oxide scales spallation were the iron-based alloys (none losted parts of their scales during cooling). The nickel-based were themselves rather resistant against this phenomenon, except after oxidation at the highest temperature 1200°C which led to too thick scales to allow them to do not suffer spallation. The worst alloys of this study are the cobalt-based alloys. These ones, not rich enough in chromium to be really have a chromia-forming behaviour, were often covered by a very thick multi-composed oxides scales, which led to early spallation start and severe mass losses.

References