EFFECT OF CHROMIUM AND NIOBIUM ADDITIONS ON THE CYCLIC OXIDATION BEHAVIOR OF GAMMA TITANIUM ALUMINIDES

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One of the challenges in the use of Ti-Al alloys in high-temperature applications is the development of alloys with good oxidation resistance, which can be significantly affected by small amounts of alloying additions and other factors [1-4]. Of particular importance is the response to thermal cycling, which can induce stresses leading to spallation of the protective oxide scales, and thus increased oxidation rates.

Cr and Nb are two common alloying additions to γ Ti-Al alloys. Cr is generally detrimental to the oxidation behavior when added in small amounts (<4%), but is beneficial when added is larger amounts. Nb, on the other hand, is generally beneficial to the oxidation resistance of Ti-Al alloys. Fortunately, when the two elements are added simultaneously, the beneficial effect of Nb appears to dominate. Nb-containing alloys are resistant to both isothermal and cyclic oxidation. The thermal stresses generated in oxide scales during thermal cycling increase with increasing scale thickness, so the time for initial spallation on Nb-containing alloys (with thinner scales) is longer than that for Ti-Al-Cr alloys. However, there is evidence that the scale thickness at which spallation begins is also larger for Ti-Al-Cr alloys. Fig. 1 shows the weight changes at which the sample weight begins to decrease for several results from the literature [5-14]. Although, scale spallation generally occurs before the overall weight decreases (*i.e.* weight may still increase, but at a lower rate), this decrease in weight can be used for comparing the onset of spallation for different alloys. The weight for initial spallation decreases with increasing temperature, because cycling from a higher temperature produces larger stresses, so a thinner scale will spall. Fig. 2 shows that the decrease in weight for Nb-containing alloys [8-21] occurs at smaller weight gains, which suggests that Cr may improve the resistance to spallation through factors such as improved scale adherence or toughness.

In this paper, these and other effects of Cr and Nb additions on the cyclic oxidation of Ti-Al alloys will be discussed.

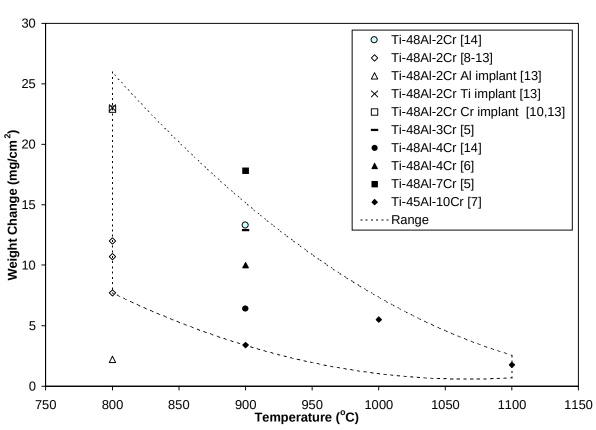

Figure 1. Weight change for initial weight decrease during cyclic oxidation of Ti-Al-Cr alloys.

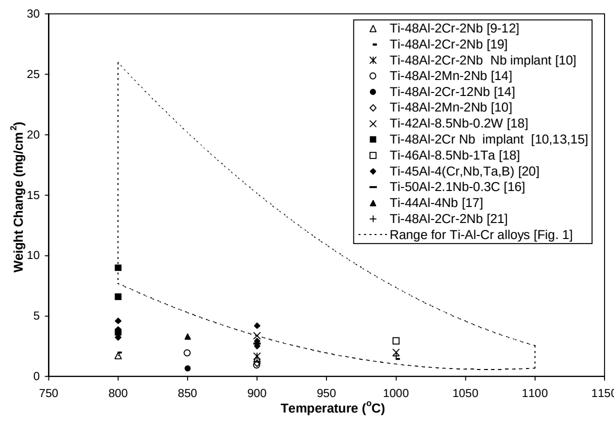

Figure 2. Weight change for initial weight decrease during cyclic oxidation of Nb-containing Ti-Al alloys.

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