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Characterization of the transient oxidation at heating in the case of simple chromium-containing alloys reinforced by carbides

Patrice BERTHOD, Lionel ARANDA

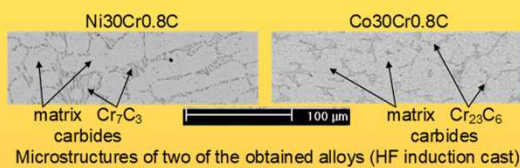
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Boulevard des Aiguillettes, BP 70239, 54506 VANDOEUVRE-LES-NANCY (France)

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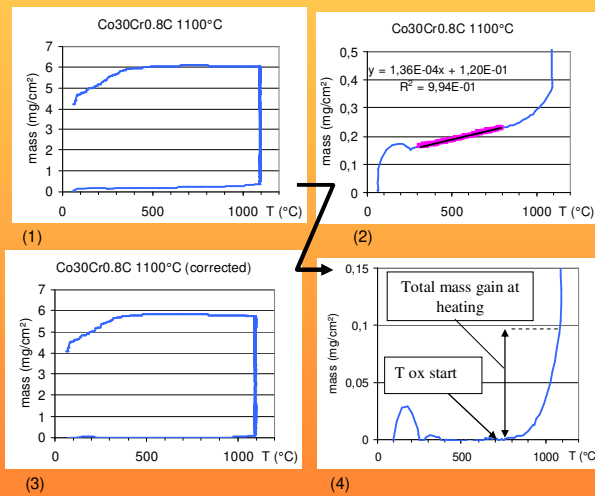
During heating up to high temperatures, refractory alloys or superalloys undergo an early oxidation before reaching a stationary temperature. This transient oxidation, which becomes faster and faster when temperature increases, induces a mass gain which finishes to be significant. This first mass gain achieved when the targeted temperature is reached must be known, for example in order to better specify the following parabolic rate of isothermal oxidation. The purpose of this work is to characterize this transient oxidation by considering the mass measurements recorded during the heating parts of thermogravimetry tests performed with six simple alloys: three low carbon ones (M-30wt.%Cr-0.2wt.%C) and three high carbon ones (M-30wt.%Cr-0.8wt.%C) where M=Fe, Co or Ni. It was looked at which temperature the mass change of the sample began to be significant, and the total mass gain obtained during the whole heating was estimated.

EXPERIMENTAL

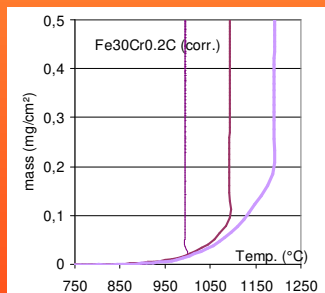
ELABORATION OF THE ALLOYS



CORRECTION OF THE TG CURVES FROM THE ARCHIMEDES' THRUST

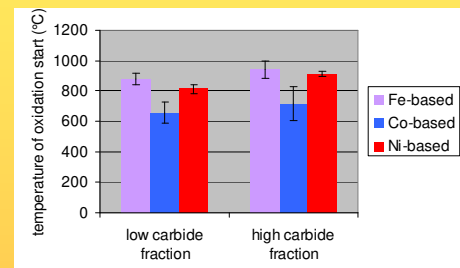


Example of plot, correction and exploitation of the thermogravimetry measurements in order to characterize the transient oxidation at heating

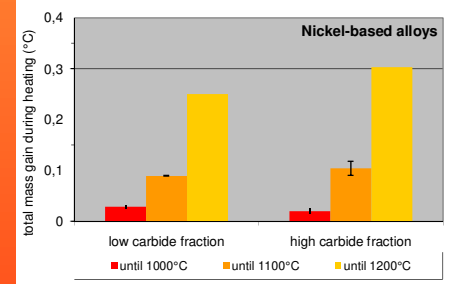
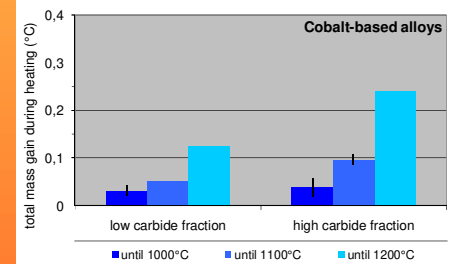
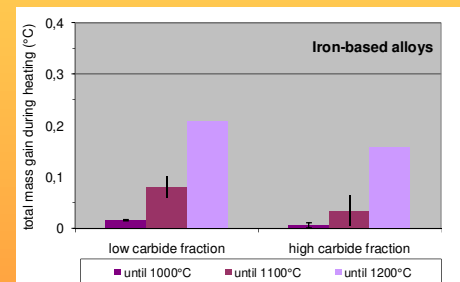


Example illustrating the good reproducibility of the oxidation start at heating for three thermogravimetry tests performed for a same alloy

RESULTS



Temperature of oxidation start at heating versus the quantity of carbides in the microstructure, for the three couples of alloys



Total mass gains achieved during the whole heating for all alloys, versus the carbides quantity in the microstructure

The carbon content or carbide fraction as well as the base element obviously influence the transient oxidation at heating. The temperature of oxidation start tends to be higher for a high fraction of carbides than for a low fraction of carbides (i.e. oxidation becomes significant earlier for the low carbon alloys than for the high carbon alloys), and in general for the iron-based and nickel-based alloys than for the cobalt alloys. In the case of the nickel alloys and of the cobalt alloys, a higher carbides fraction leads to a higher mass gain at the end of heating to a same temperature, while it is the contrary for the iron alloys.