THERMAL AND MECHANICAL PROPERTIES AT HIGH TEMPERATURE OF CO-BASED SUPERALLOYS STRENGTHENED BY MC CARBIDES WITH M=TA OR NB

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Polycrystalline Co-based superalloys strengthened by carbides can be used at high temperature in several domains (aeronautics, energy production, hot industrial processes…). Versions involving MC carbides often display particularly good mechanical properties at more than 1100°C. Most of them contain tantalum carbides but strengthening may be also achieved by other MC carbides in such alloy base. In this work, the effects of the presence of niobium carbides, and of their morphological modifications after aging, on the high temperature properties of cobalt-based superalloys were investigated. Comparison will be done with more classical TaC-strengthened Co-based superalloys.

Alloys containing 25wt.%Cr, 0.5wt.%C and 7.5 wt.%Ta or 3.9 wt.% Nb were elaborated by casting. Samples were kept as-cast and others were heat-treated at 1200°C during 100h to simulate the aging of these alloys in service. In their two states the superalloys were first subjected to electron microscope observation for characterizing their microstructures, and to differential thermal analysis (DTA) for specifying their melting ranges. As-cast and aged samples were tested in creep resistance at 1100°C, 1150°C and 1200°C under 20MPa.

DTA results showed that the solidus temperature is greater for the TaC-containing alloy than for the NbC-containing ones. The melting range is thus wider for the NbC-containing alloy than for the other alloy. In both cases, the thermal treatment decreased the two temperatures, but they remained significantly higher than 1200°C. Concerning the creep tests, it appeared that the TaC-reinforced alloy, preliminarily aged or not, is stronger than the NbC-containing one, at all temperatures. Additionally it was observed that mechanical weakening resulted from a preliminary aging, for both alloys. To finish, exposures of samples to air at different high temperatures were carried out to access to first data concerning the oxidation behaviour of the two alloys in their two states.

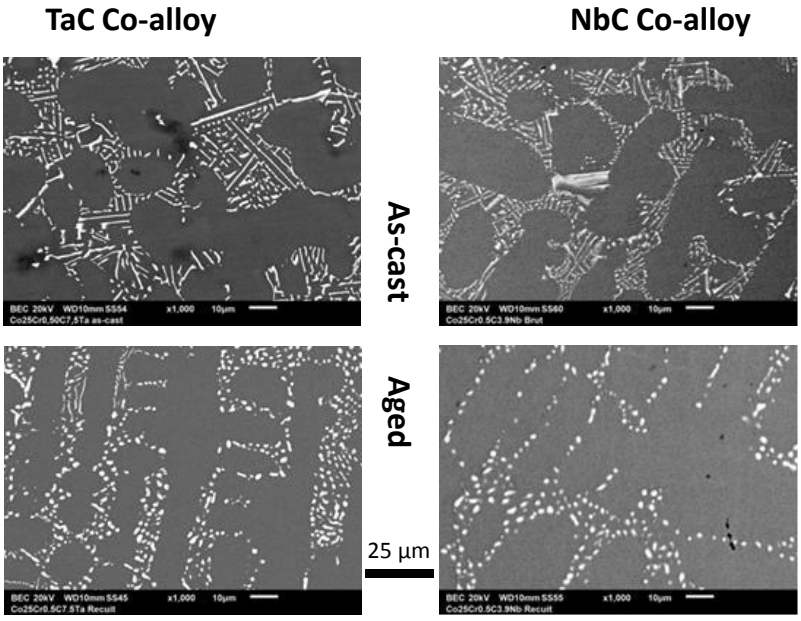

Figure 1 – Microstructures of both alloys in the two states (SEM/BSE)