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Volumetric Gas Hydrogenation of a Nickel Alloy 718

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Abstract – This work aims to study high temperatures interactions of hydrogen with an age hardenable, nickel based superalloy. Different microstructures were obtained by variations of the aging treatments. The analysis procedures involve gaseous permeation, thermal programmed desorption (TPD), tensile tests, fracture analysis and scanning electron microscopy. The results were compared with electrochemical hydrogen permeation tests results.

The nickel based superalloy 718 is an age hardenable alloy, widely used in aerospace, nuclear and petrochemical industries for applications involving corrosive environments and extreme temperatures. Such material is basically a Ni-Fe-Cr alloy with metastable, ordered γ” (Ni_3Nb) precipitates as main strengthening factor [1].

Through the several applications of the superalloy 718, hydrogen usually takes part in all of such processes, and its interactions with microstructure are object of study worldwide, as it is accepted that internal and external hydrogen causes ductility losses [2]. Particularly, in nuclear pressurized water reactors, high operational temperatures and neutron irradiation can increase hydrogen effect over the material.

Through different heat treatments over 1mm thick annealed and cold rolled samples, three different microstructures were obtained: as received, 800°C/6h (aged) and 800°C/20h (overaged). After proper samples preparations, high temperature hydrogen gas permeations at 500°C for 30 days were conducted, in order induce hydrogen diffusion in a high temperature environment.

This work aims to study the high temperatures interactions of hydrogen with various microstructures obtained from different aging treatments. The analysis procedures involve gaseous permeation, thermal programmed desorption (TPD), tensile tests, fracture analysis and scanning electron microscopy. The results were discussed and compared with electrochemical permeation tests results.

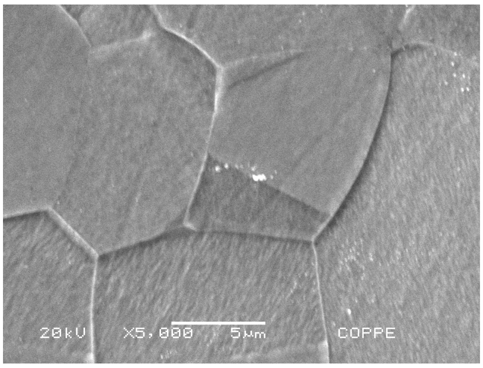

Figure 1: Microstrucuture of the superalloy in as-received condition showing no precipitation at grain boundaries

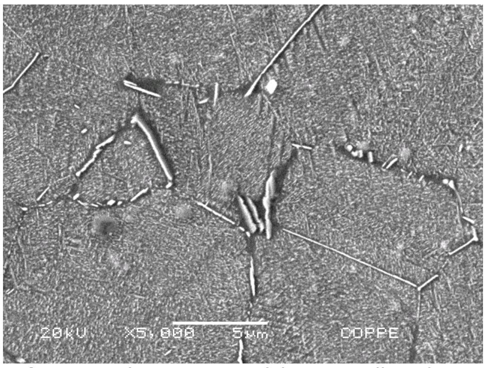

Figure 2: Microstructure of the superalloy after aging treatment of 800°C for 6h. The delta phase precipitates are distributed along grain boundaries.

References

[1] ASM International, *ASM specialty Handbook: Nickel, Cobalt and their Alloys*, Materials Park, Ohio, 2000;
[2] L. Liu, K. Tanaka, A. Hirose, K. F. Kobayashi, *Science and Technology of Advanced Materials* 3 (2002) 335–344;