EFFECT OF TWO-STEP AGING HEAT TREATMENT AND RARE EARTH ADDITIONS ON THE MICROSTRUCTURE AND MICROHARDNESS OF NANOSTRUCTURED SUPERALLOY INCONEL 718

Hansel Manuel Medrano Prieto[1], Audel Santos Beltran[1], Veronica Gallegos Orozco[1], Javier Servando Castro Carmona[2], Hector Camacho Montes[2], Carlos Gamaliel Garay Reyes[3], Gustavo Rodriguez[3], Marco Antonio Ruiz Esparza Rodriguez[3], Juan Carlos Guía Tello[3], Ivanovich Estrada[4], Roberto Martinez Sanchez[3]
[1]Universidad Tecnologica de Chihuahua Sur, Departamento de Nanotecnología, Mexico. [2]Universidad Autónoma de Ciudad Juárez, Departamento de Ingenieria, Mexico. [3]Centro de Investigación en Materiales Avanzados, S.C., Metalurgia e integridad estructural, Mexico. [4]Centro de Investigación en Materiales Avanzados, S.C., Física de Materiales, Mexico.

Inconel 718 is plenty used in elevated work temperatures because it possesses high resistance to oxidation and good mechanical properties; its principal applications are in aeronautics and aerospace engines, nuclear reactors and the chemical industry. Lately, research has been carried out on the influence of rare earth elements in superalloys to improve their microstructural characteristics and mechanical properties. The utilization of Rare earth elements like tantalum, niobium, rhenium, hafnium, and ruthenium has grown to explore their effects in superalloys and improve their mechanical and microstructural characteristics. Researchers have reported considerable effects on the solid-solution strengthening mechanism due to additions of elements such as cerium and yttrium due to favor the lattice mismatch and generate modifications of eutectic phases and carbides, enhancing the performance of superalloys. Nonetheless, the utilization of cerium, lanthanum, neodymium and praseodymium in superalloys has not been highly explored.

The modified superalloy with rare earth (RE) additions was fabricated by mechanical alloying. The commercial alloy and the mixture Misch metal with a purity of 99 % and content of Ce:La:Nd:Pr: 50-55:30-35:5-10:5-10: wt% were used to obtain the new alloys with contents of 0.1, 0.2 and 0.3 wt% of RE. Spex 8000 Mill was used to produce the alloys. The consolidation was developed in a furnace at 1300 ºC for 3 h. The samples were solution treated at 980 °C for 1 h with quenched in water at room temperature, and the standard two-step aging treatment was carried out. Characterization of the alloys was performed in a JSM-7401F SEM, Panalytical x-ray diffractometer, and the hardness evaluation in LM300 AT Vickers tester.

The nanostructured superalloy with RE additions presents a homogeneous and refined microstructure formed for oxides, carbides and δ-precipitates (Ni_3Nb) homogeneously distributed. From the microstructural observations, higher contents of RE the superalloy favored the refinement of the microstructure and provoked increments in hardness values in the sintered, solubilized and aged conditions. The maximum hardness values were observed in the alloy with 0.2 RE (wt. %).

Keywords: Rare earth, Inconel-718, Aging-Heat-treatment

Presenting author's email: ivanovich.estrada@cimav.edu.mx