MICROSTRUCTURE AND HARDNESS EVOLUTION OF INCONEL 718 ALLOY MODIFIED WITH TRACES OF CE/LA AND SINTERED BY HIP

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Nickel- Based superalloys are extensively used in aeronautic/aerospace engines, energy, and chemical industries owing to its offers high oxidation resistance and excellent mechanical properties at elevated temperatures. During the last decade, researchers have reported essential advances on the effects of rare- earth additions in superalloys, some of the elements mostly used to improve the mechanical and microstructural properties are: rhenium, hafnium, tantalum, niobium, and ruthenium. Furthermore, other investigations have reported that elements such as yttrium and cerium have significant effects due they promote the modification of carbides, eutectic phases and contributes with a solid solution strengthening mechanism. However, the use of cerium/lanthanum and sintering by Hot Isostatic Pressure (HIP) has not been widely studied in superalloys, although researches have reported that the rare- earth elements additions and HIP sintering favor the improvement the microstructural and mechanical properties. A commercial superalloy and a mixture of (Ce/La- 50/50) with a purity of 99 % were employed to fabricate alloys with 0.1, 0.2, and 0.3 Ce/La (wt.%) by the mechanical alloying route. A milling time of 5 h in a high- energy mill Spex- 8000 was used. The milling device and milling media were made hardened steel. N- heptane as the process control agent, and argon as an inert milling atmosphere were employed. Powder mass 8.5 g and a ball- to- powder ratio of 5:1 were used. A uniaxial pressure of 1.56 GPa for 5 minutes in a hydraulic press was applied to the compaction of powders. The sintering was performed in an AIP6- 30H HIP at 1200 °C for 4 h at 27000 psi under the argon atmosphere. A Panalytical X´Pert- PRO X- ray diffractometer, an SEM HITACHI- SU3500 microscope, and a TEM HITACHI- 7700 microscope were used to carry out the microstructural characterization. The Vickers hardness was evaluated in a Leco LM300- AT. The results showed that the Inconel 718 alloy presented a homogeneous and refined microstructure, which was composed of oxides, carbides, and ?- precipitates (Ni_3Nb) with acicular morphology. Besides, higher amounts of Ce/La content favored the modification of the microstructure and increased the HV values in sintered, solubilized, and aged conditions. The maximum hardness was obtained in alloy with 0.2 Ce/La (wt.%).

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