PO2089

Swelling of plasma nitrided Ni-based superalloys

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Various Ni-based superalloys were plasma nitrided at a moderate temperature of 400°C. All investigated superalloys are polycristalline and exhibit a γ phase matrix which coexists with primary carbides of W_6C type for the Haynes®230, plus a γ' phase (~ Ni_3Al) phase for the Udimet®720Li, or γ' + γ" phase (~Ni_3Nb) for the Inconel®718. The surface morphology and the microstructure of the nitrided layer in the various superalloys was characterized using white light interferometry, scanning electron microscopy and X-ray diffraction analysis while the N diffusion profiles were obtained from glow discharge optical emission spectroscopy. Nitriding results in the formation of expanded austenite as in stainless steels. The effect of the incorporation of nitrogen was investigated in terms of swelling of the surface and it is shown that swelling depends on the thickness of the nitrided case as well as on the ratio of the present phases. Comparison with recent investigations in austenitic stainless steel 316L and in MC2 second generation Ni–based single crystal superalloy, which is a mixture of γ and γ' phases, suggested that it is related to the nitriding efficiency of the various phases. Nitrided superalloys were also vacuum-annealed at 650°C for 24 hours to test the evolution of the modified layer. After annealing, precipitations of nitrides as well as nitrogen diffusion lead to the shrinkage of the γ phase at grain boundaries or at the interfaces with carbides.

Keywords
nitriding
Ni superalloys
swelling
diffusion
annealing