

OR2504

Microstructural characterization of plasma nitrided γ and γ' phases in nickel-based superalloysJean-Baptiste Dubois¹, Fadella Larek¹, Frédéric Danoix², Raphaële Danoix², Michel Drouet¹, Luc Pichon¹¹Prime Institute, FUTUROSCOPE CHASSENEUIL, France ²Groupe de Physique des Matériaux, Saint-Étienne-du-Rouvray, France

jean.baptiste.dubois@univ-poitiers.fr

Nickel-based superalloys are used in extreme conditions and nitriding is investigated as a way to improve their properties. In previous works, nitriding at moderate temperature (400°C) was performed in a RF plasma based reactor at the floating potential on various Ni-based superalloys to determine the specific nitriding behavior of γ/γ' phases and the role of microstructural parameters such as grain size, crystallographic orientation, volume fraction of γ' or chemical compositions. It was shown that plasma nitriding leads to the incorporation of nitrogen in γ with the formation of expanded austenite, known as the S-phase or γ_N , with around 25% at. of N in solid solution, as well as nitrides (CrN). Regarding the γ' precipitates, incorporation of nitrogen is strongly dependent on its composition and higher Ti/Al ratio results in deeper N diffusion. The present study has been conducted to provide more information, at the submicrometric/nanometric scale, about the chemical and structural modifications of the γ/γ' phases induced by nitriding. Scanning and transmission electron microscopy (combined with EDS, EELS and EFTEM), as well as tomographic atom probe characterizations have been performed on two representative superalloys: Udimet 720Li and single crystal MC2. Inhomogeneous distribution of N has been revealed in the γ matrix and γ' precipitates. Nitrided γ matrix is composed of coherent γ_N , CrN precipitates and a third FCC phase resulting from the decomposition of the expanded austenite associated with N and Cr depletion. In nitrided γ' , formation of the expanded phase was not observed but coherent nanometric nitrides were evidenced as well as larger precipitates at the surface resulting from Ni extrusion when N is incorporated in γ' . Further investigations are performed to identify the nitrides in γ' which could differ depending on the superalloy studied (TiN, AlN, ...)

Keywords

Plasma nitriding

Ni-based superalloys

Transmission electron microscopy