Micro-abrasive wear of a low-temperature plasma nitrided Inconel 625 superalloy

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Low-Temperature Plasma Nitriding (LTPN) was carried out in an Inconel 625 superalloy at 420 °C for 20 h, in a 75% N_2 + 25% H_2 atmosphere. After plasma nitriding, the specimens were characterized by X-ray diffraction, scanning electron microscopy, microhardness measurements, linear scratch and micro-abrasion wear tests. The tribological properties of Inconel 625 are compared with the properties obtained after the LTPN treatment. Friction coefficient, mechanical failure mode, and critical loads for damaging the nitrided case were determined.

Keywords: Inconel 625, plasma nitriding, microabrasion, linear scratch test

1. Introduction

Inconel 625 has been used in petrochemical and aerospace industries due to its excellent corrosion and high-temperature properties. Nevertheless, the surface properties of this alloy are not high enough to guarantee a good tribological performance. Low-temperature plasma nitriding (LTPN) increases surface hardness of FCC alloys, without reducing the corrosion resistance [1]. A nitrogen supersaturated expanded FCC (γ_N) hard layer is formed on the surface. No systematic reports on the tribological behavior of plasma nitrided Ni-based alloys were found in the literature. The tribological behavior of PN Inconel 625 under slurry-microabrasion and linear scratch tests is carried out.

2. Methods

Inconel 625 specimens were plasma nitrided at 420 °C for 20 h in 75% N_2:25% H_2, under 250 Pa. Calowear microabrasion and instrumented linear scratch tests were carried out to compare the tribological behavior, the operating wear mechanisms, the apparent friction coefficients, and the nitrided layer failure modes.

3. Results

An N supersaturated expanded FCC γ_N layer, ~7.2 µm thick formed on the surface of the alloy.

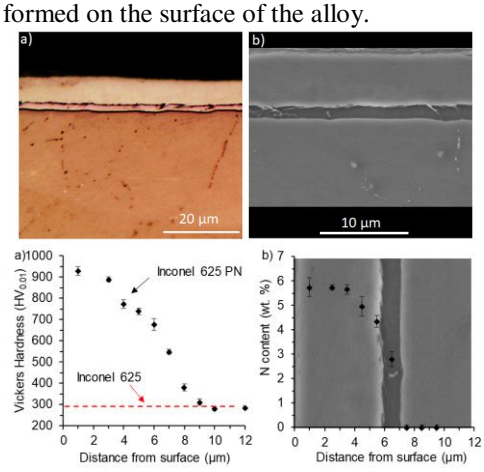


Fig. 2 Microstructure, microhardness and nitrogen concentration profiles of Inconel PN 625.

The Calowear and linear Scratch tests showed that the PN Inconel 625 performed much better than the non-nitrided specimen.

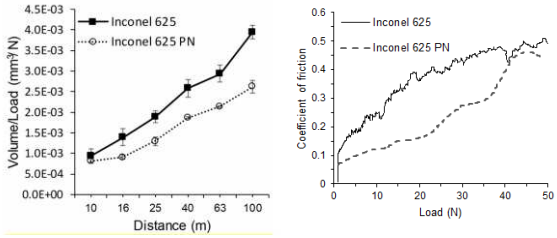
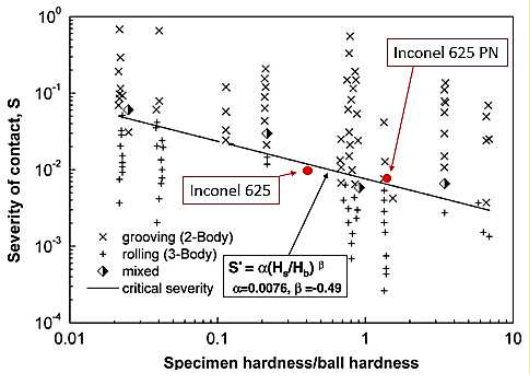


Fig. 4 Micro-abrasive response of PN Inconel 625 in microabrasion and linear scratch tests.

4. Discussion

A discussion is made based on the effects of hardness, mean size and morphology of abrasive particles, abrasive concentration in the slurry, and the tribological system (sample and ball). Different wear modes could be correlated with the severity of contact [2].



5. References

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