Microstructural Analysis of the nano TGO layer in TBC on Ti-6Al-4V after cyclic oxidation test for aerospace application

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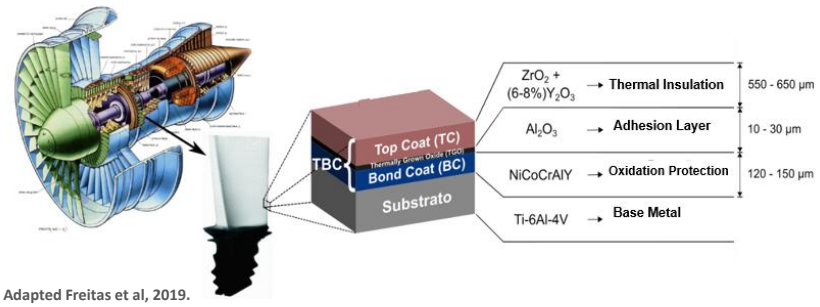
INTRODUCTION



Adapted Freitas et al, 2019.

METHODOLOGY

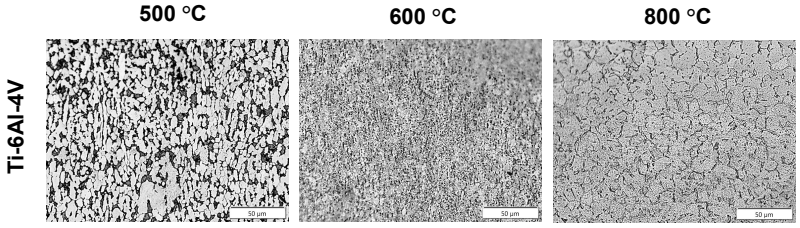
Cyclic oxidation tests were conducted in air at 500 °C, 600 °C, and 800 °C using an automated furnace. Each test consisted of 100 cycles, with each cycle comprising 60 minutes at the target temperature followed by 10 minutes of exposure to air at ambient temperature.

The tests were performed on both uncoated and TBC on Ti-6Al-4V alloy.

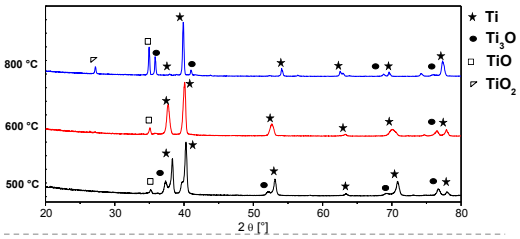
The TBC comprised a BC of NiCrAlY and a TC of yttria-stabilized zirconia containing 8 wt% yttria (8YSZ). Both layers were deposited using a commercial air plasma spray (APS) process.

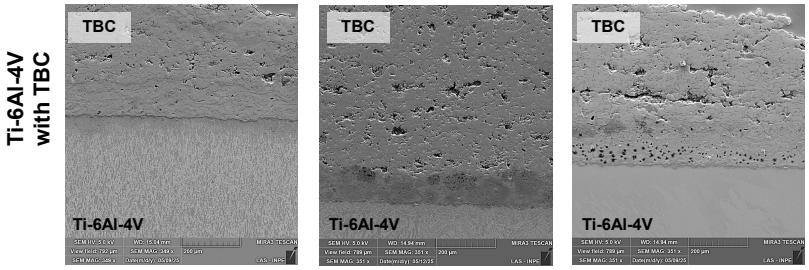
RESULTS

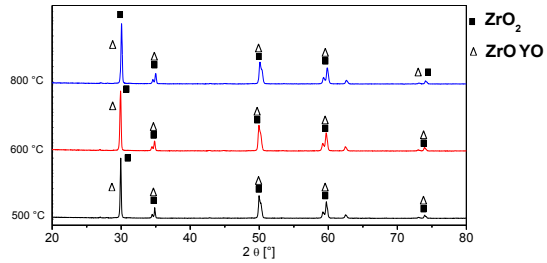
Microstructure of the Ti-6Al-4V uncoated and with TBC after 100 cycles oxidations.



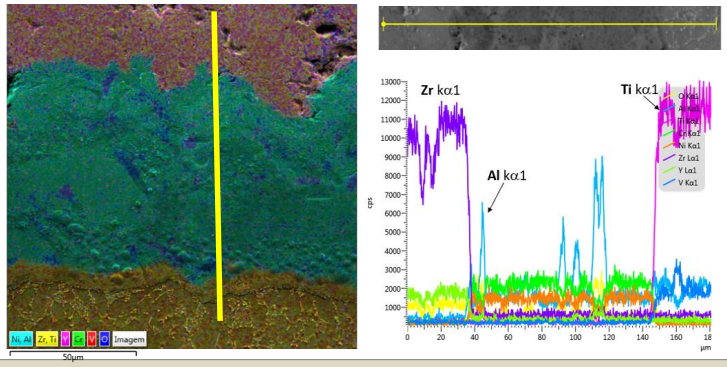
XRD diffractograms







The analysis of TGO thickness was carried out using SEM, EDS mapping, and EDS line scan.
Images of the Ti-6Al-4V with TBC after 100 cycles oxidations at 500°C.



The analysis of TGO thickness of the Ti-6Al-4V with TBC after 100 cycles oxidations and the grains size **[G]** (ASTM E112-13) of the Ti-6Al-4V.

	TGO (µm)	G TBC	G Ti-6Al-4V
500 °C	6.56 ± 0.80	10.5	11.0
600 °C	8.53 ± 0.47	10.0	10.5
800 °C	9.16 ± 1.86	9.5	9.0

CONCLUSIONS

The TBC remained intact and adherent to the Ti-6Al-4V alloy under all test conditions. The microstructural analysis revealed that the Ti-6Al-4V experienced grain growth with increasing temperature; however, this effect was less pronounced with the TBC, demonstrating its effectiveness in protecting the substrate against cyclic oxidation. These results confirm the reliability of the TBC system in enhancing the high-temperature performance of Ti-6Al-4V alloys.

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