Joining Ti6Al4V to Al_2O_3 by diffusion bonding assisted by reactive nanolayers

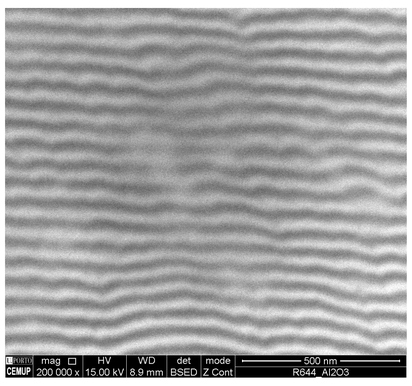
Marcionilo Silva Jr.[1,2], A. S. Ramos[3], F. Viana[2,4], M. T. Vieira[4], M. F. Vieira[2,4] and S. Simões[2,4]

[1] Department of Mechanical Engineering, Federal University of Amazonas, Manaus 69080-005, Brazil.
[2] CEMMPRE – Centre for Mechanical Engineering, Materials and Processes, University of Port, R. Dr. Roberto Frias, 4200-465 Porto, Portugal.
[3] CEMMPRE- Department of Mechanical Engineering, University of Coimbra, R. Luís Reis Santos, 3030-788 Coimbra, Portugal.
[4] INEGI – Institute of Science and Innovation in Mechanical and Industrial Engineering, R. Dr. Roberto Frias, 4200-465 Porto, Portugal

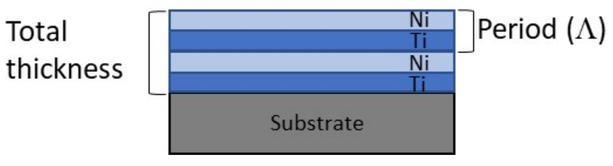
Abstract

Diffusion bonding is one of the most suitable processes for producing joints with microstructural and mechanical soundness. This work aims at investigating joining of Ti6Al4V to Al_2O_3 using Ni/Ti reactive multilayer thin films (alternated Ni and Ti layers) deposited by magnetron sputtering onto the base material. Due to their exothermic and nanometric character, less demanding processing conditions can be used as temperature and pressure.

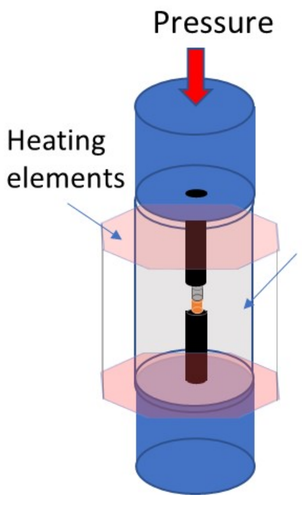
Sputtering



Periods (λ) : ±50 nm
Total thickness: ±3 μm



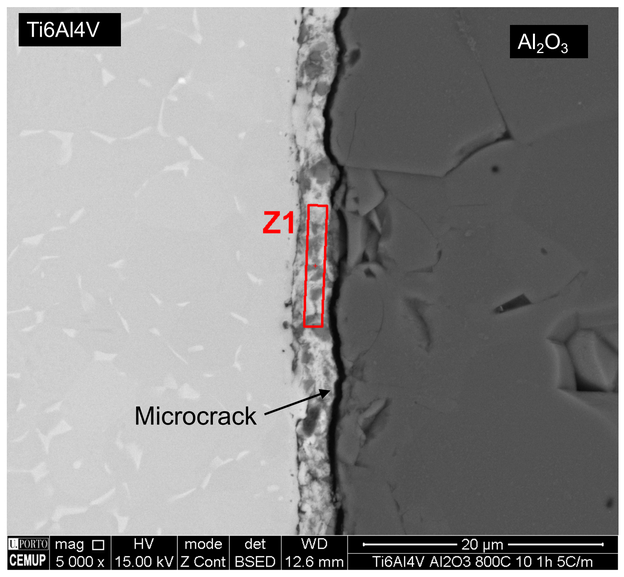
Diffusion Bonding Process

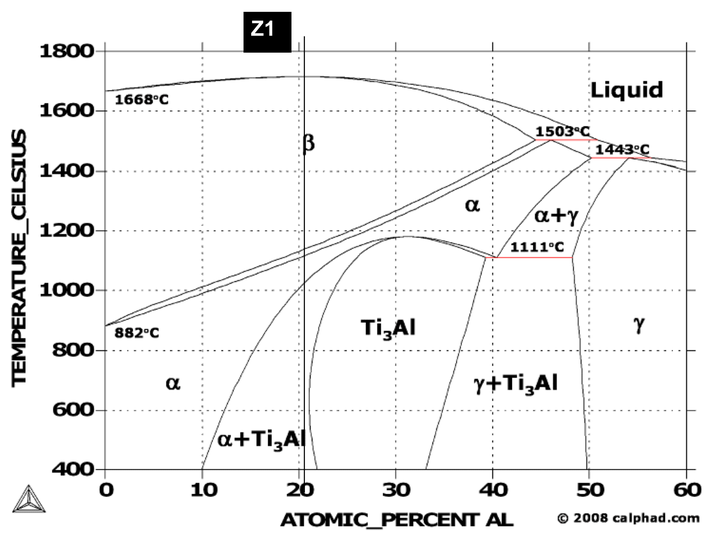


Temperature : 800°C
Bonding Time : 60 min.
Pressure : 5 to 50 MPa

Results and Discussion

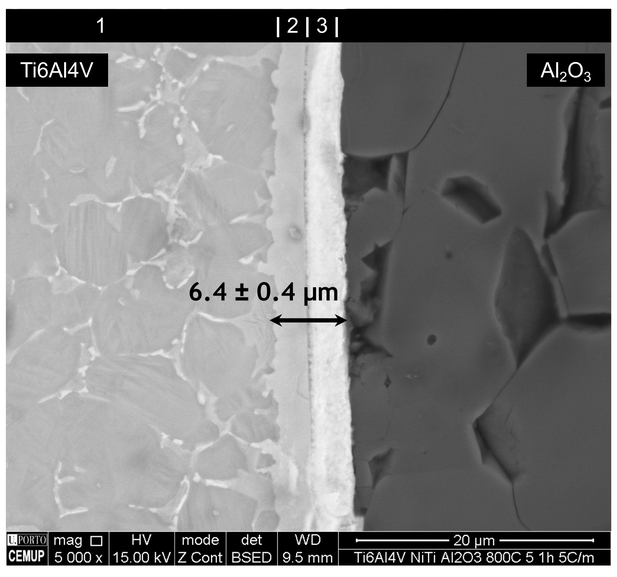
Without Multilayers



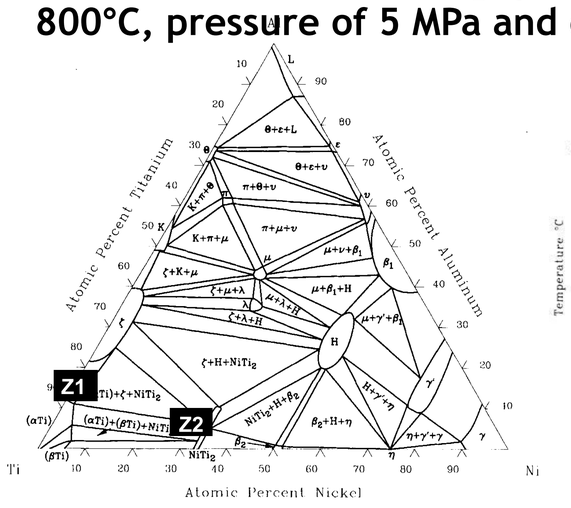


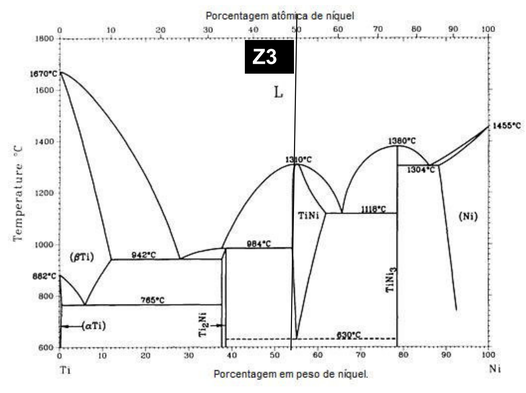
- Interface was produced by bonding experiments without multilayers at 800°C, 60 min and 5 MPa. Microcracks can be observed throughout the interface.
- The interface present a layer of α-Ti and Ti_3Al.

Ti/Ni Multilayers



- Joined Ti6Al4V to Al_2O_3 using Ni/Ti multilayers with ± 50 nm period with temperature 800°C, pressure of 5 MPa and dwell time 60 min.





- The thickness of the interface is thin, 6.4 ± 0.4 μm. No cracks were observed.
- The interface is composed of $NiTi_2$ and NiTi layers.

Conclusions

The main aim in this study is obtain sound joints between Ti6Al4V to Al2O3 using diffusion bonding process with reactive multilayer thin with 50 nm of period (Λ). It is possible reduce the bonding conditions (temperature, pressure and time). However intermetallic compounds are formed in the interface region.

ACKNOWLEDGEMENTS

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