

Reaction-assisted diffusion bonding of Ti-6Al-4V to Al₂O₃

Marcionilo Silva Jr.^{1,2}, A. S. Ramos^{3*}, F. Viana^{2,4}, M. T. Vieira⁴, M. F. Vieira^{2,4} and S. Simões^{2,4**}

¹ Department of Mechanical Engineering, Federal University of Amazonas, Manaus 69080-005, Brazil.

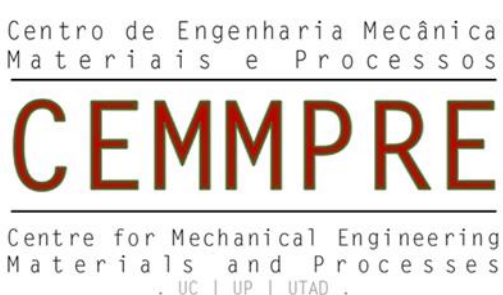
² CEMMPRE - Centre for Mechanical Engineering, Materials and Processes, University of Porto, R. Dr. Roberto Frias, 4200-465 Porto, Portugal

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

*sofia.amos@dem.uc.pt

**ssimoos@fe.u.pt



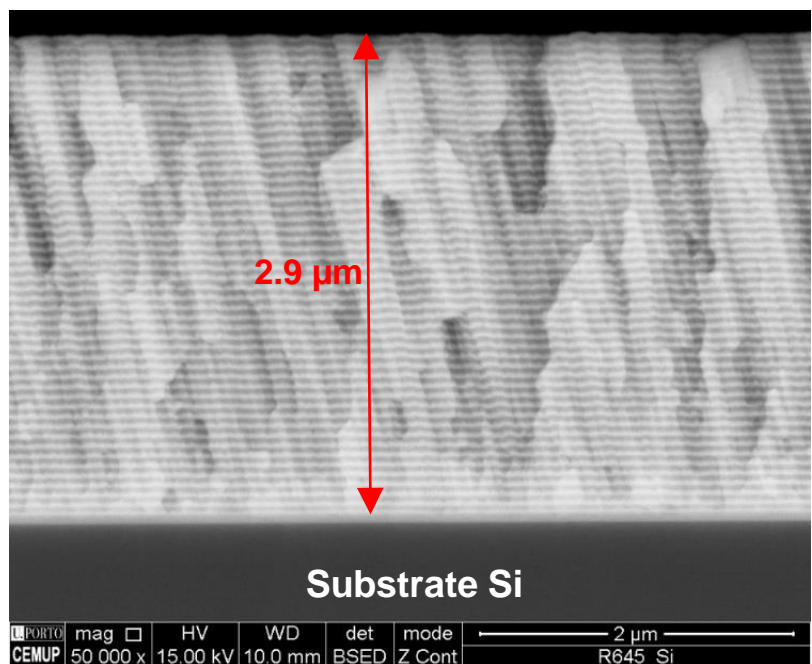
Objective

Diffusion bonding is one of the most suitable processes for producing joints with microstructural and mechanical soundness. This work aims at investigating joining of Ti-6Al-4V to Al₂O₃ using Ni/Ti reactive multilayer thin films (alternated Ni and Ti nanolayers) deposited by magnetron sputtering onto the base materials. Due to their exothermic and nanometric character, these multilayers might improve the diffusion bonding process between these dissimilar materials.

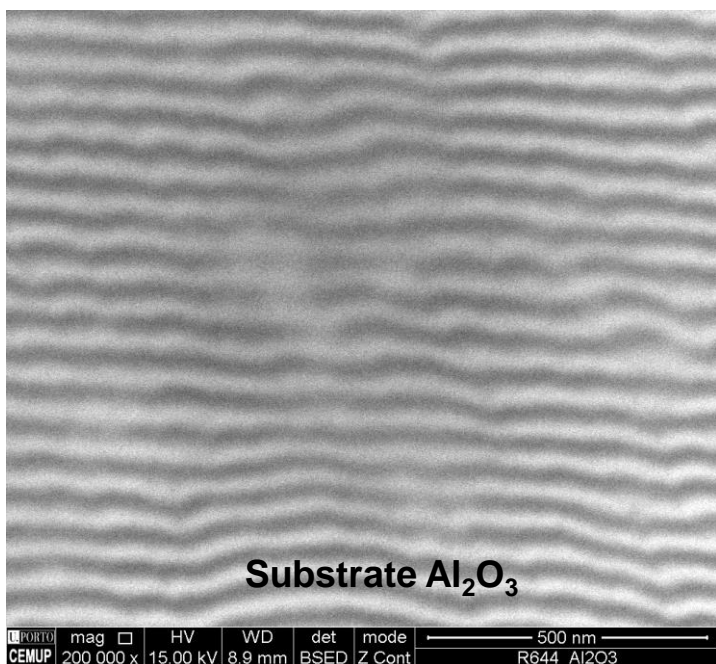
Depositions by Magnetron Sputtering



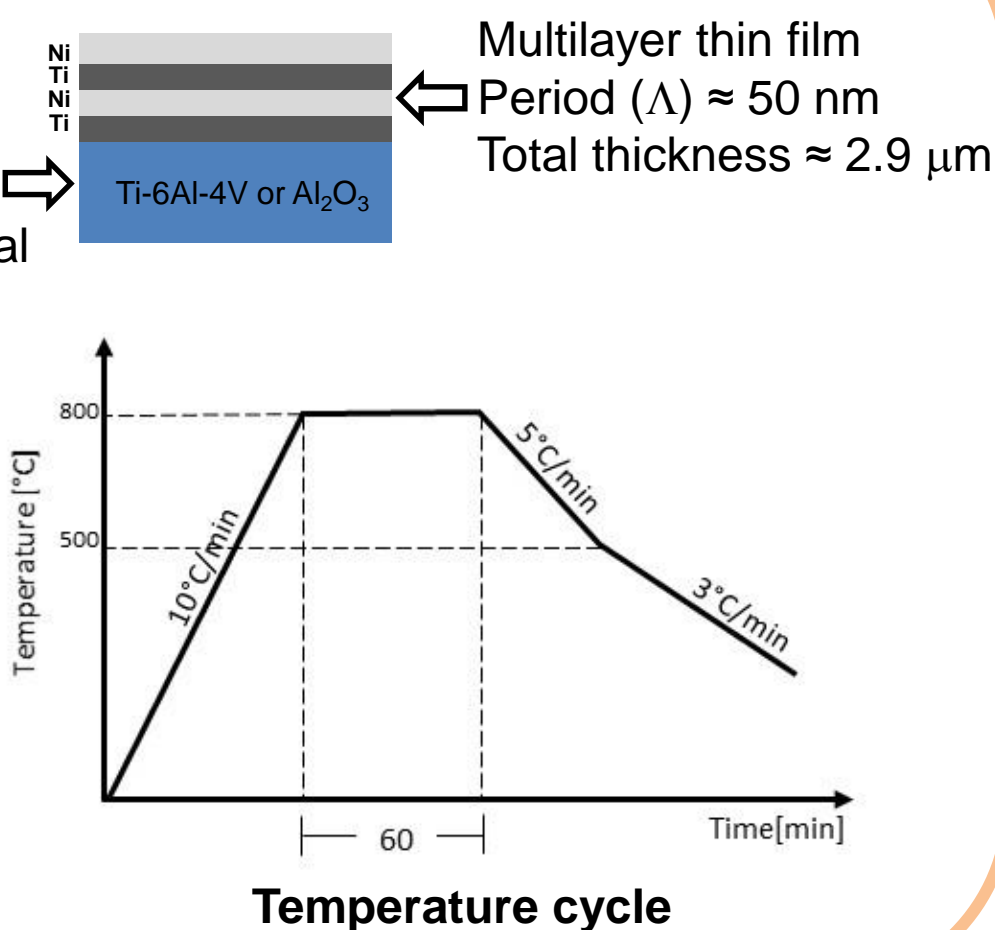
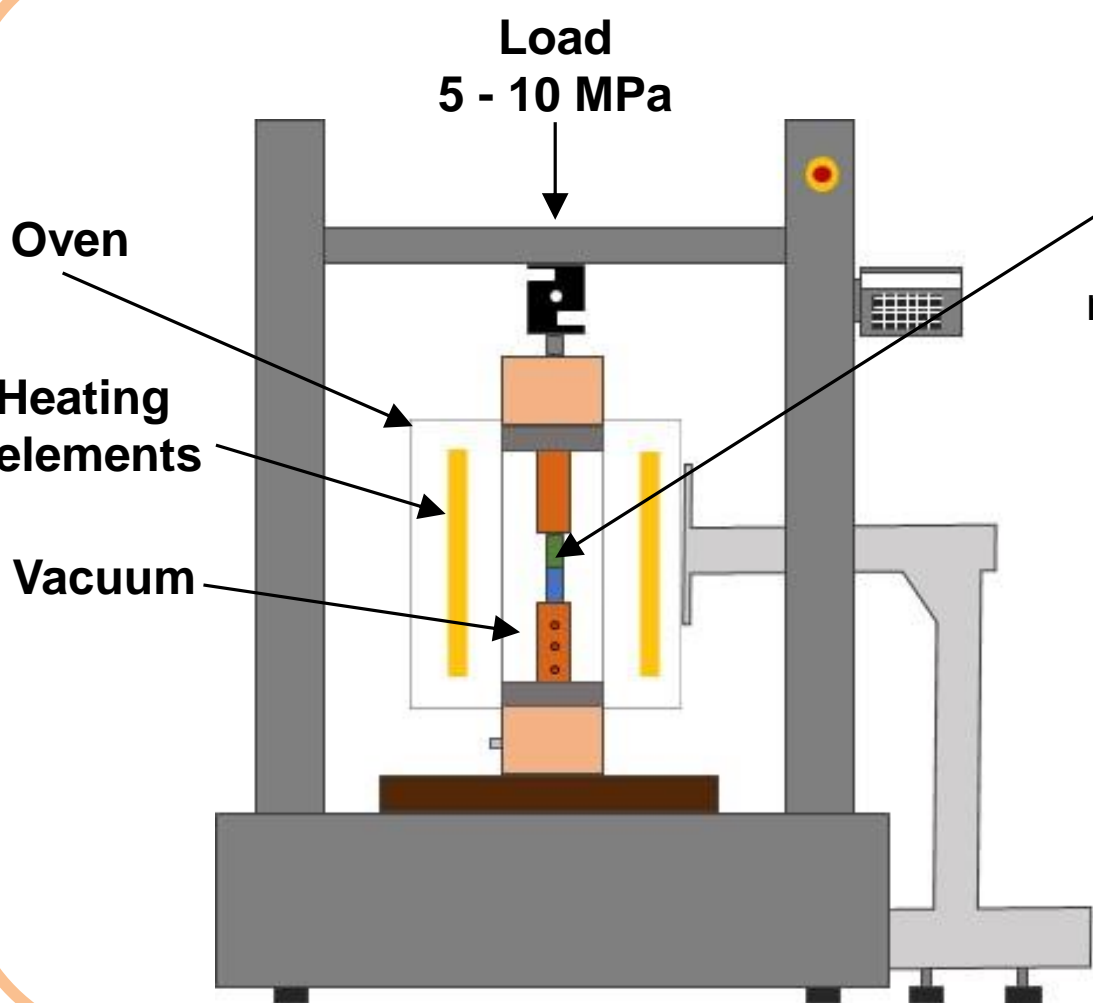
DC Magnetron Sputtering



Ni/Ti reactive multilayer thin film
 $\Lambda \approx 50\text{nm}$

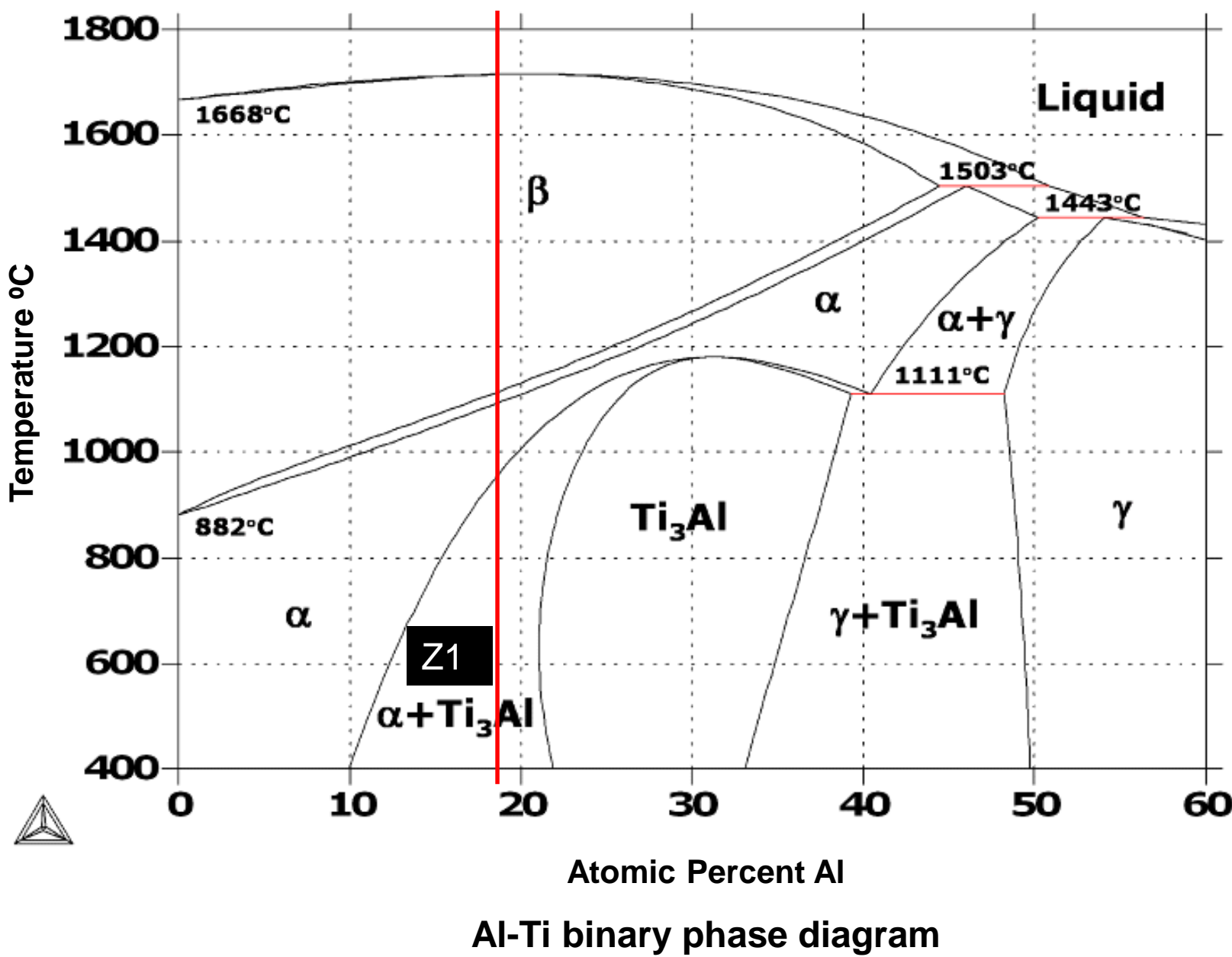
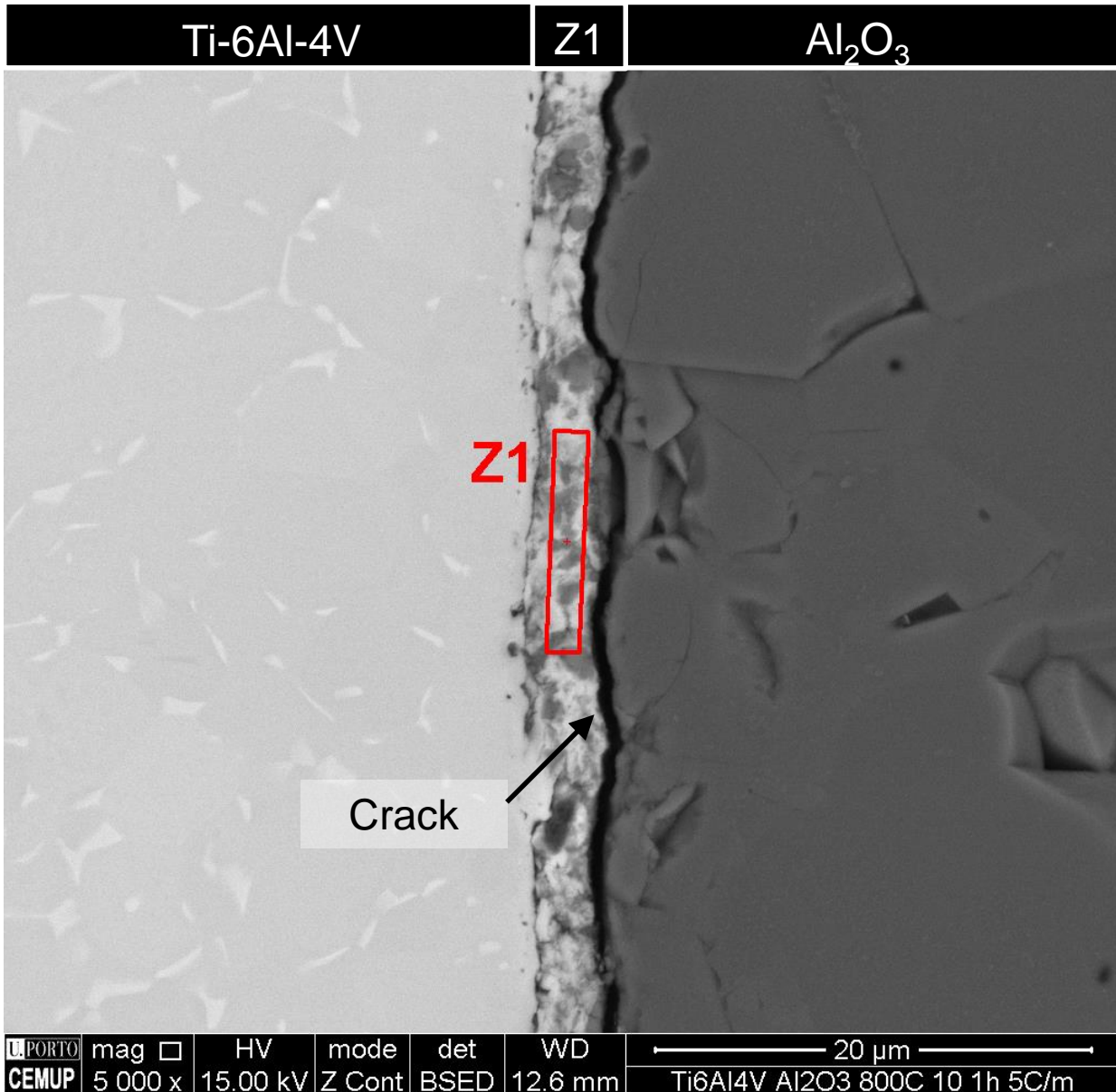


Diffusion Bonding Process



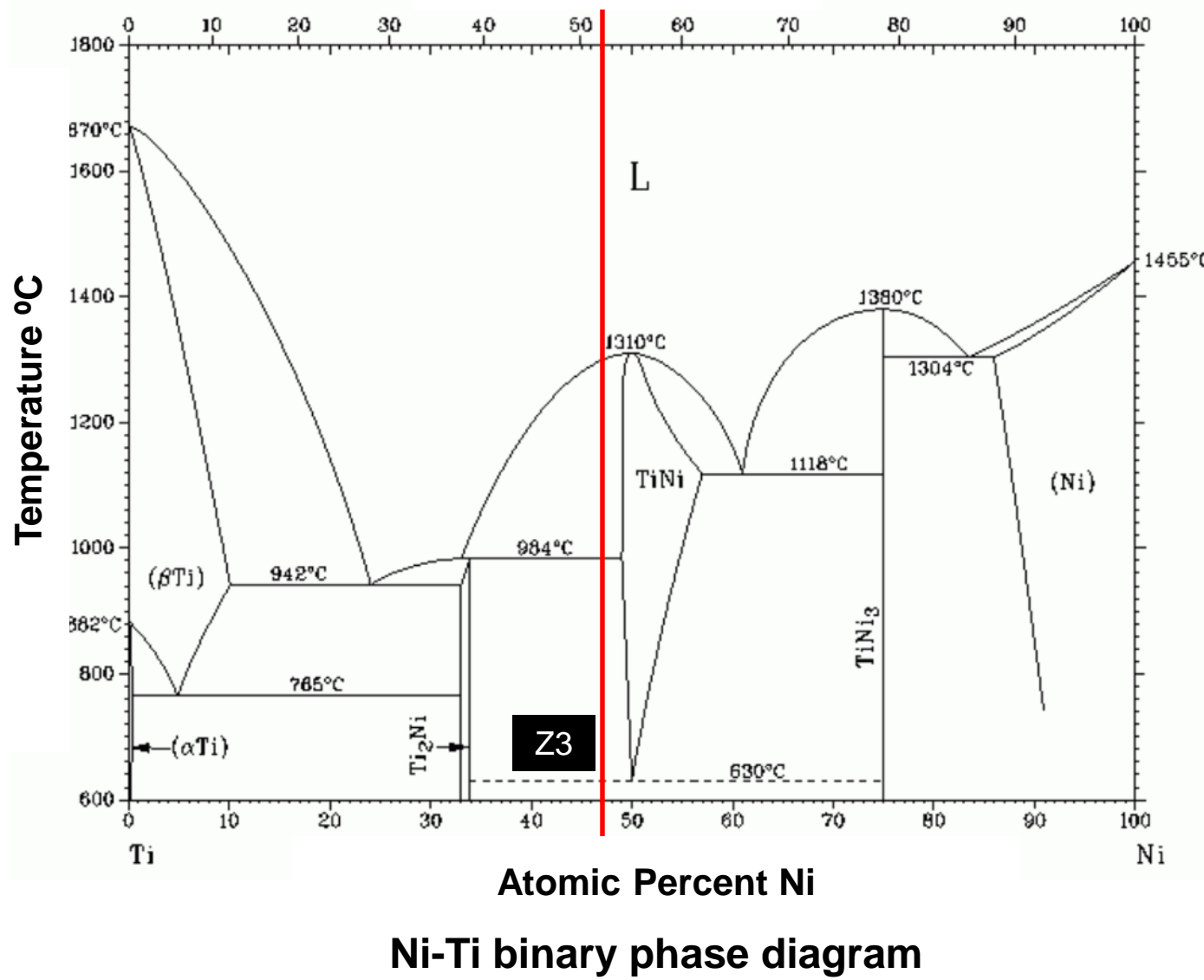
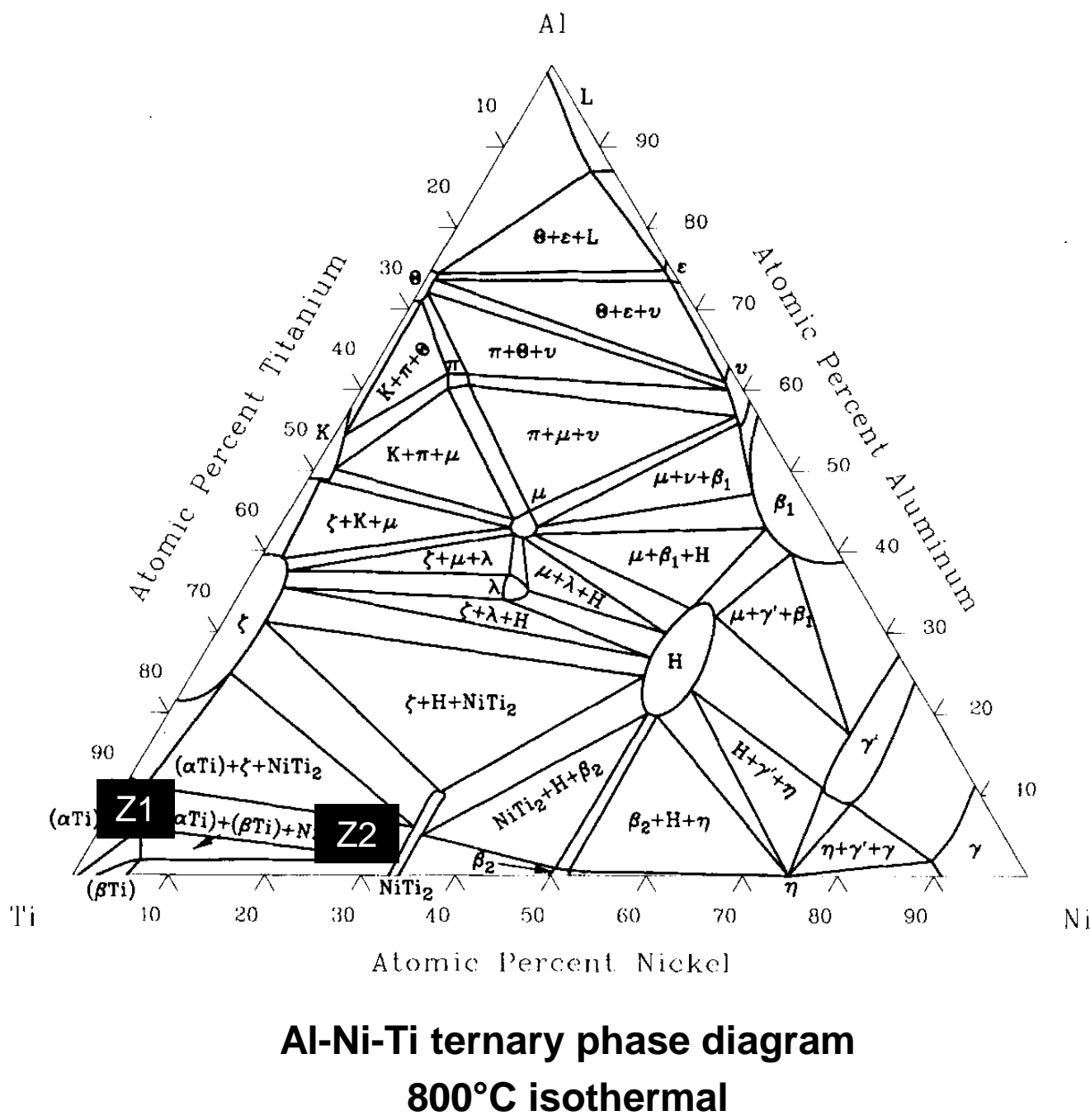
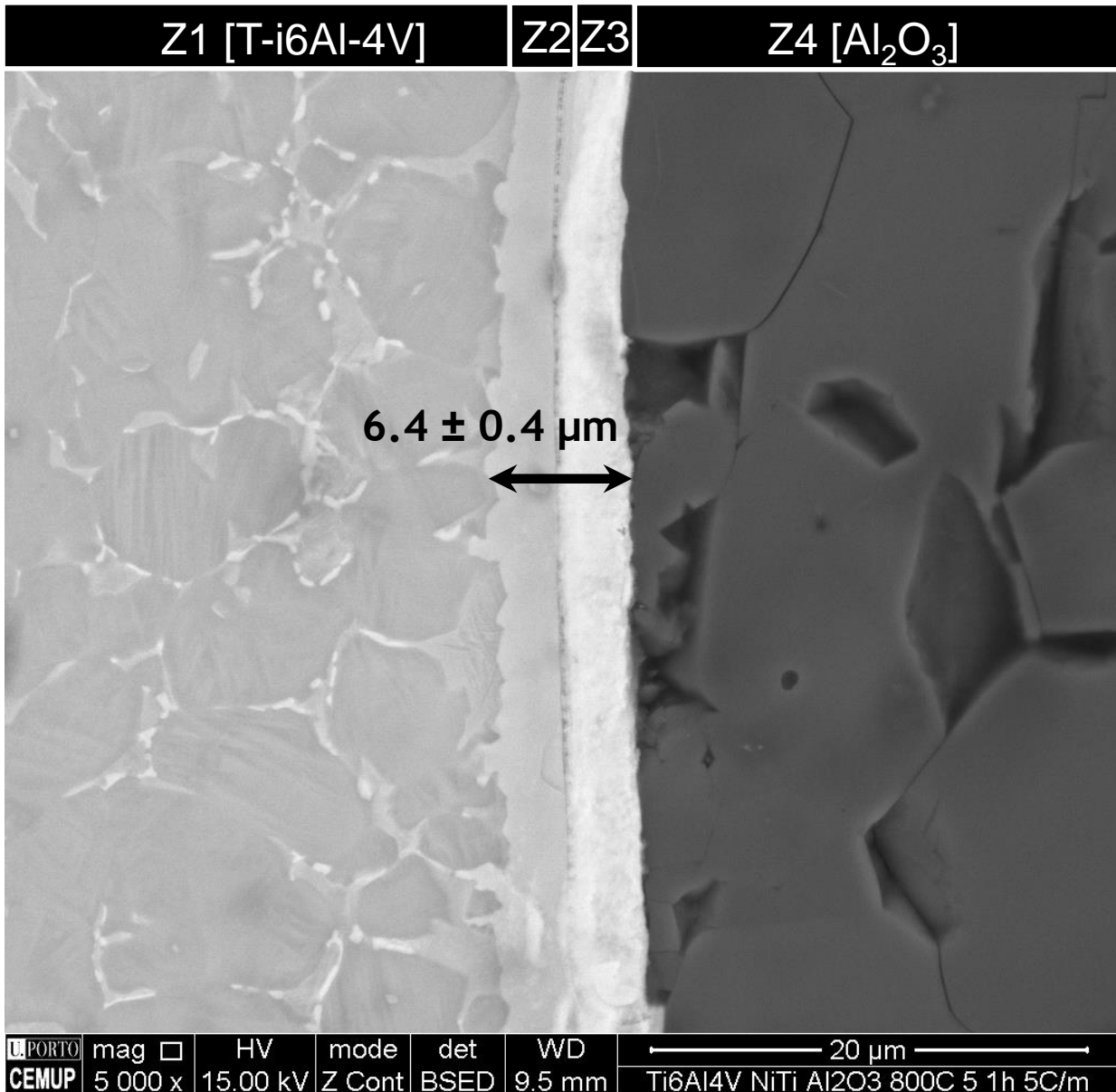
Results and Discussion

Without multilayers



- Diffusion bonding was carried out at 800° C, 60 min and 5 MPa, without multilayers
- Cracks can be observed throughout the interface
- Possible phases at the interface : α -Ti and Ti_3Al

Ni/Ti multilayers



- Ti-6Al-4V was diffusion bonded to Al₂O₃ at 800° C, 60 min and 5 MPa, using Ni/Ti multilayer thin films
- Interface without pores or cracks
- Possible phases composing the interface: Z1 - Ti (α) + Ti (β), Z2 - NiTi_2 , Z3 - NiTi

Conclusions

The main goal of this study is to obtain sound joints between Ti-6Al-4V and Al₂O₃ using the diffusion bonding process assisted by reactive multilayer thin films. The use of Ni/Ti multilayers with 50 nm period improves the quality of the joint interface. However, brittle intermetallic compounds are formed at the interface region.

ACKNOWLEDGEMENTS



This work was financially supported by: Project- PTDC/CTM-CTM/31579/2017—funded by FEDER funds through COMPETE2020-Programa Operacional Competitividade e Internacionalização (POCI) and by national funds (PIDDAC) through FCT/MCTES and by the Project UID/EMS/00285/2019