KATHOLIEKE UNIVERSITEIT
LEUVEN

Porous Ti coating by EPD of particle stabilized emulsions

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Department of Metallurgy and Materials engineering

Tina Mattheys & Annabel Braem

Outline

- Introduction
- Objective
- Method
- Experimental procedure
- Results
- Conclusion

Introduction

- **Problem: implant loosening (65%)**
- **Solution: surface morphology, porosity**

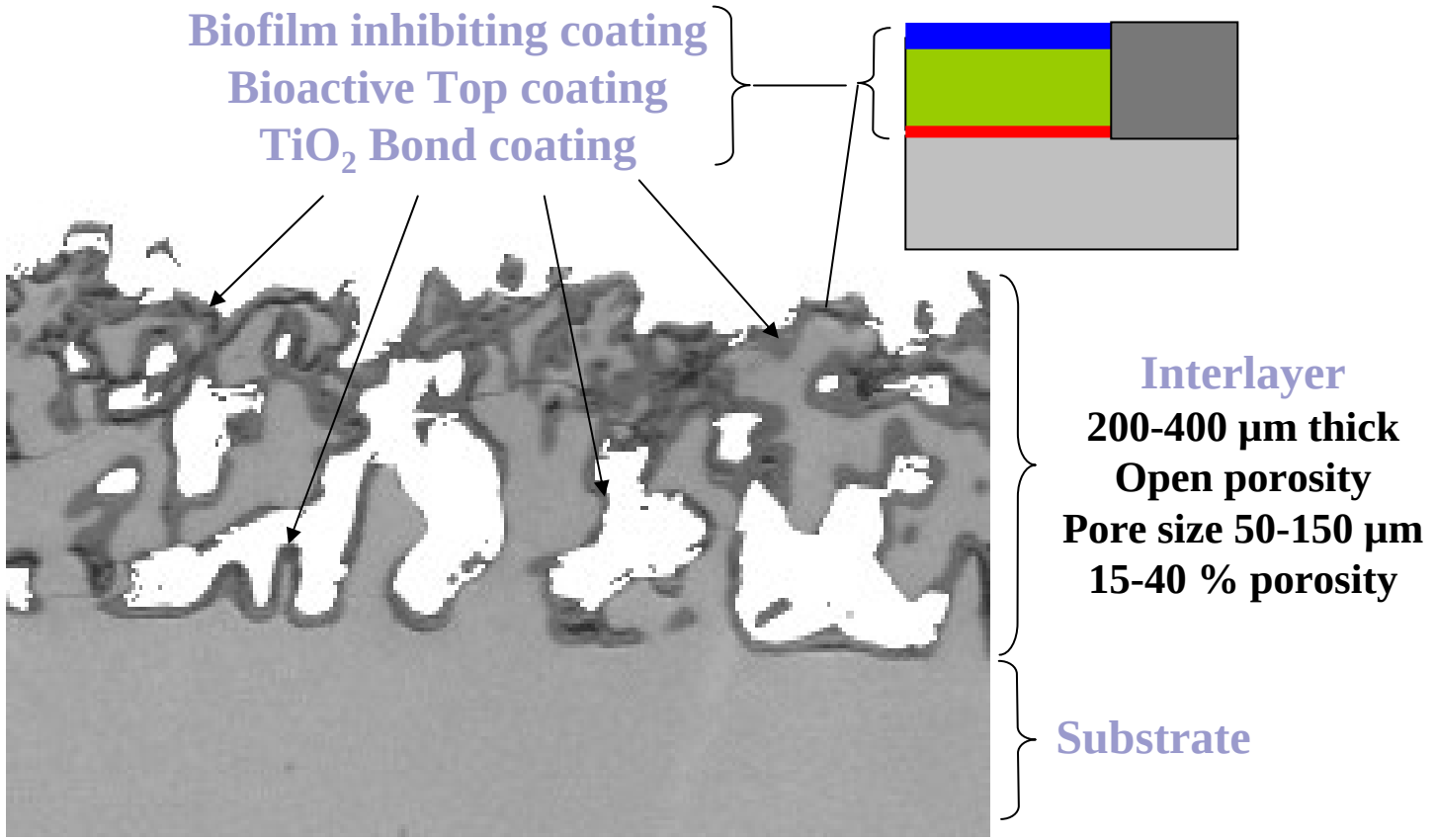
=> Mechanical fixation

bioactive topcoating

=> Bone bonding

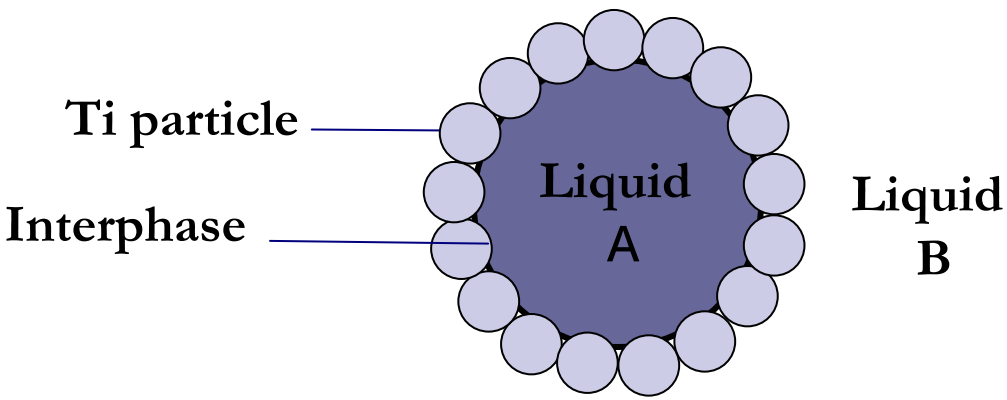
- **Study: Ti coating on Ti6Al4V substrates**

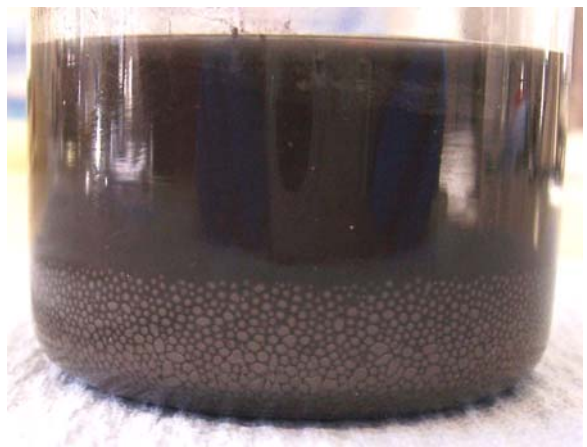
Objective


Biofilm inhibiting coating
Bioactive Top coating
TiO_2 Bond coating
Interlayer
200-400 µm thick
Open porosity
Pore size 50-150 µm
15-40 % porosity
Substrate
Bond coat, Bioactive top coat and biofilm inhibiting coating
Open porosity
Metal

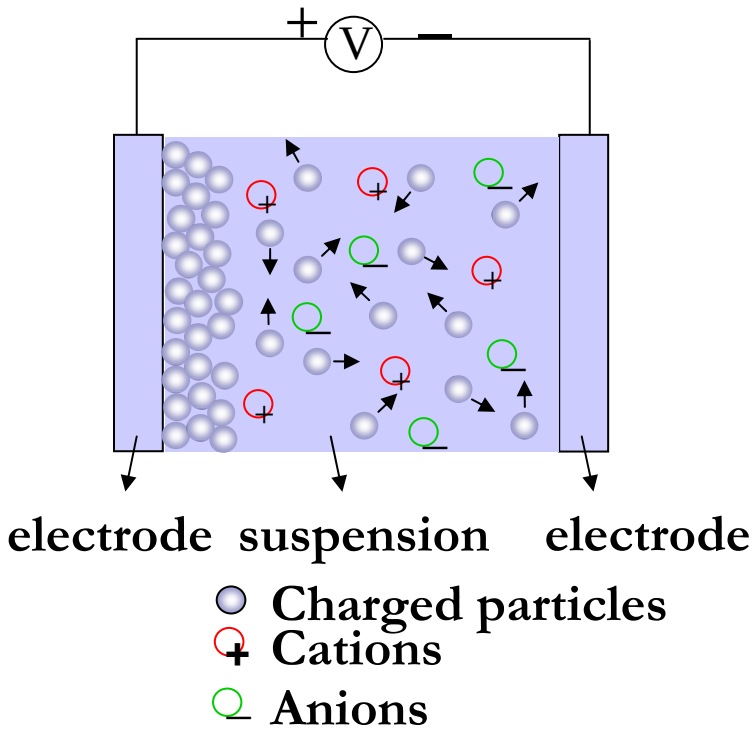
Method

- **Deposition of titanium powder on Ti-6Al-4V discs by electrophoretic deposition**
- **<u>3 step process</u>**
  - **Preparation of Pickering emulsions**





o Electrophoretic deposition



Electrophoresis

Deposition

o Consolidation of the green structure

Microwave heating in helium

Experimental procedure

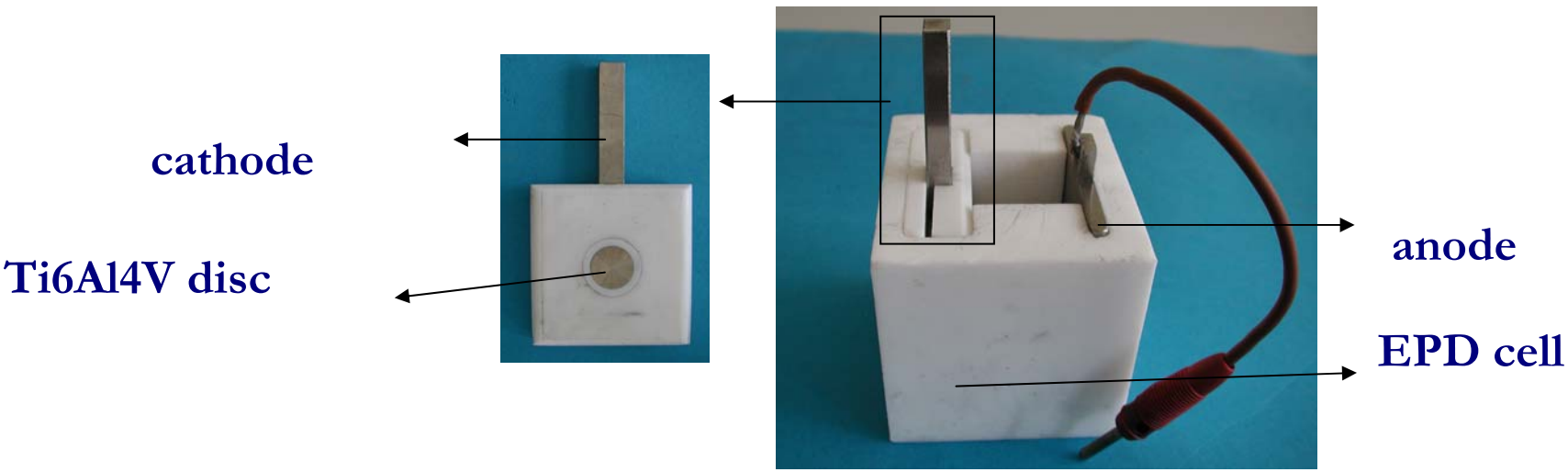
- **Preparation of Pickering emulsion**

  Continuous phase: ethanol

  Dispersed phase: paraffin oil

  Charger and binders: PEI, H_3PO_4 and acetic acid

- **Electrophoretic deposition**



o Consolidation of the green structure

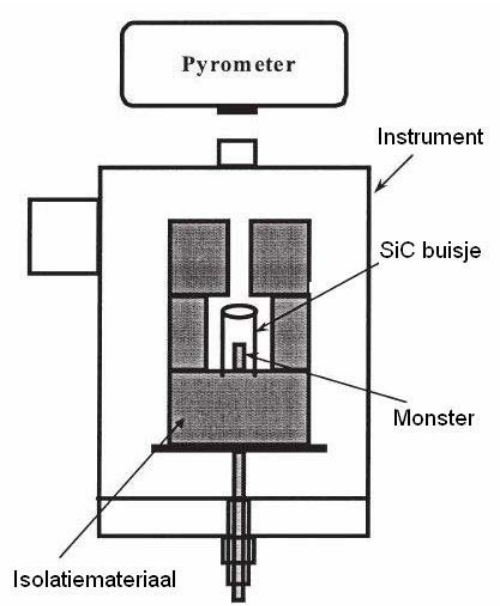
hybrid microwave heating

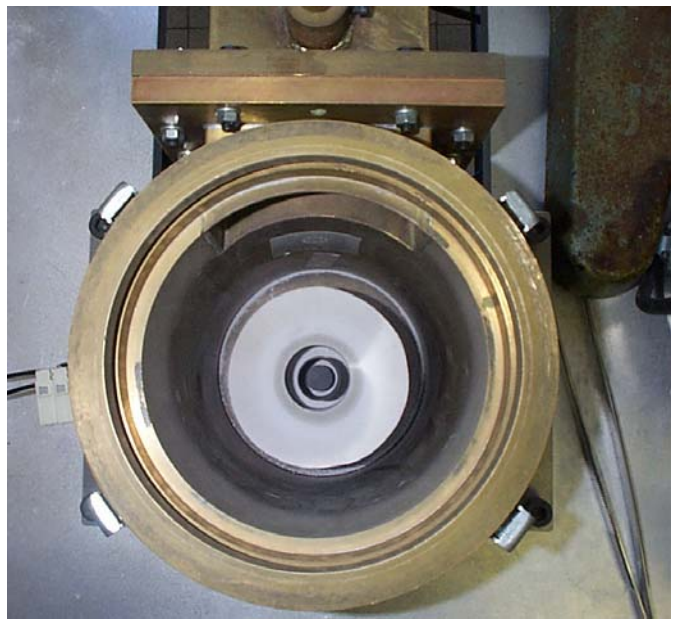
Atmosphere: Helium

Cycle: 20°C/min to 750°C for 10’

50°C/min to 1000-1100°C for 15’

Furnace cool down (120°C/min) or 2°C/min

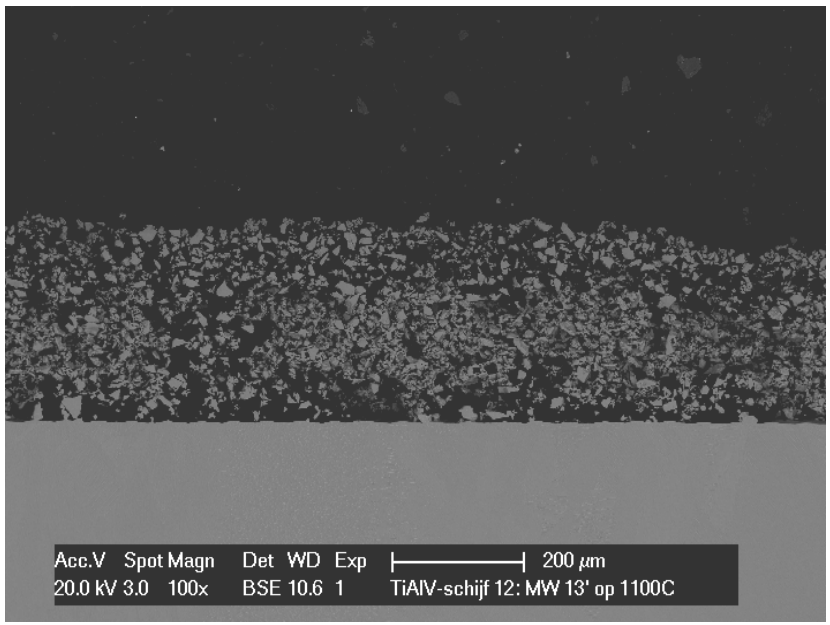




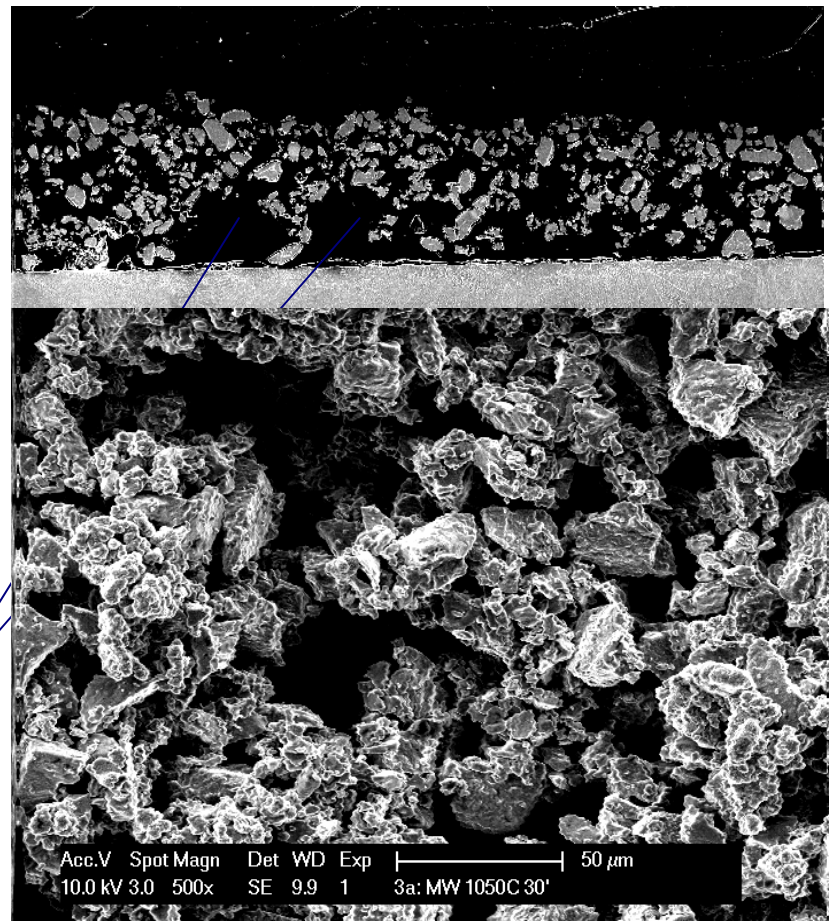
Results

o Particle suspension vs. Pickering emulsion

Ti particle suspension



Ti particle stabilized emulsion

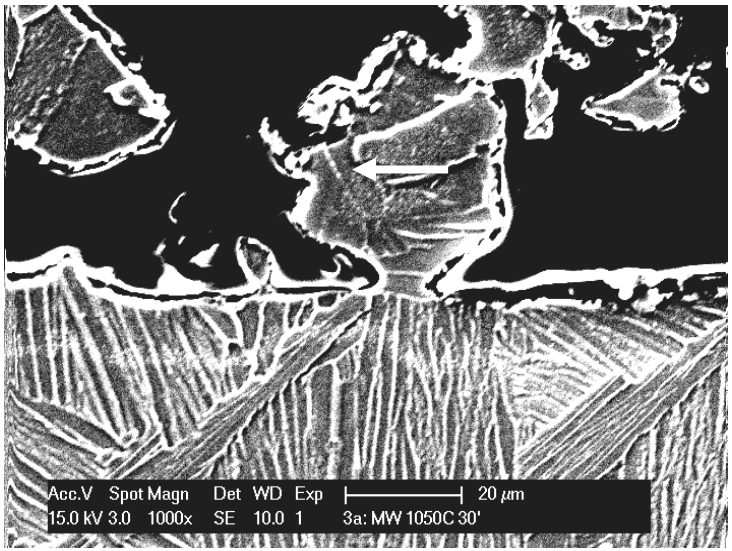


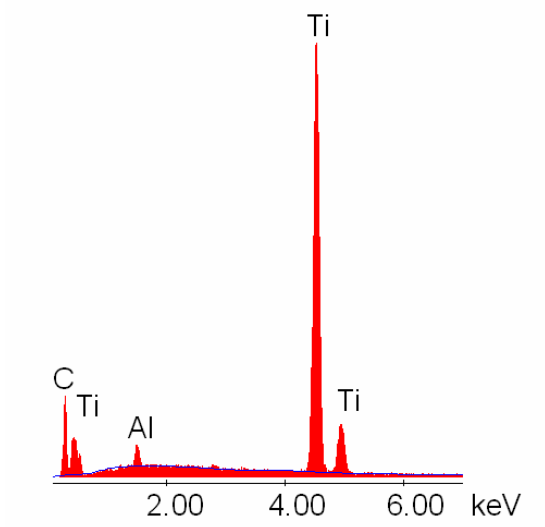
Spherical pores

o Characterisation

- **Coating thickness: ± 200 µm**
- **Pore size: ± 50 µm**
- **Porosity: open; ± 70 vol%**
- **Microstructure:**
  - **+ Neck formation**
  - **- Diffusion**
  - **- Widmanstätten structure**

o Microstructure

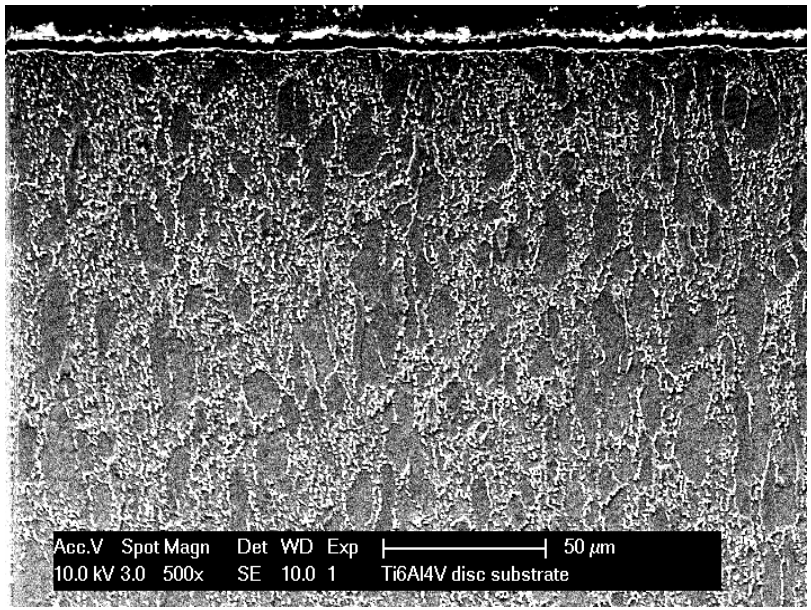




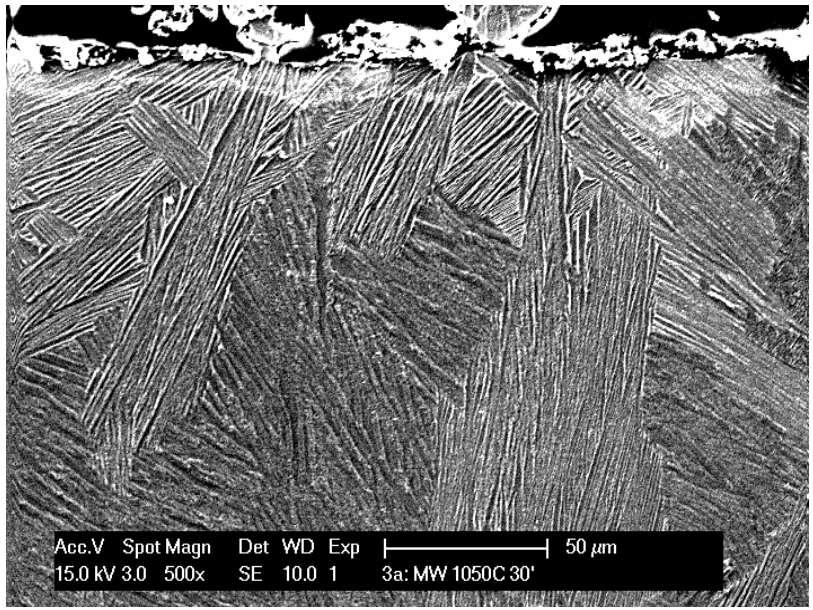
+ Neck formation => bonding between substrate and coating

- Diffusion

- Widmanstätten structure

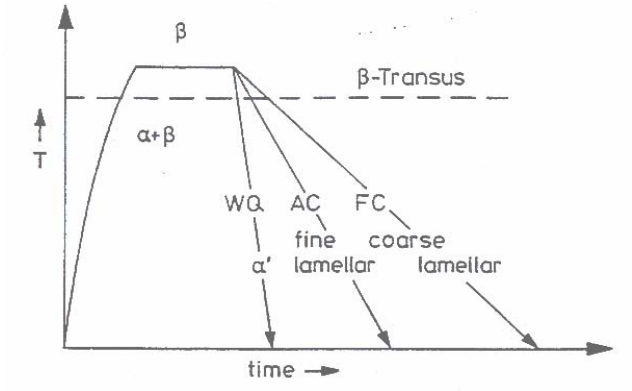


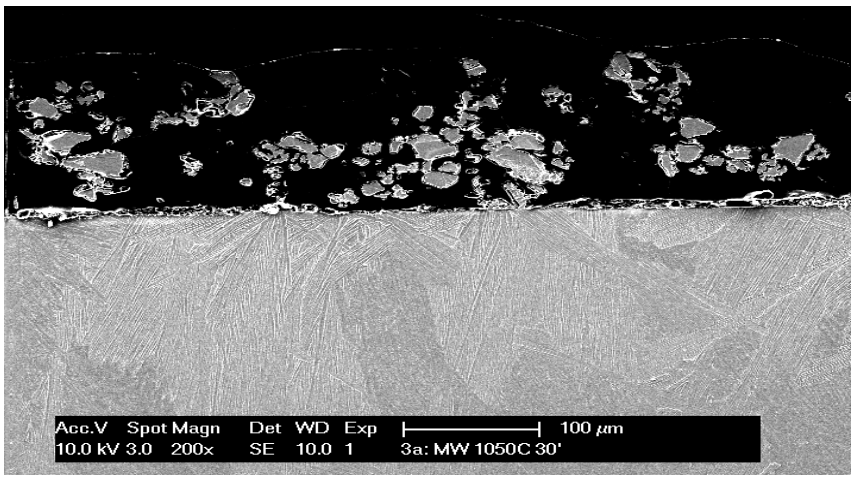
Original Ti6Al4V substrate microstructure



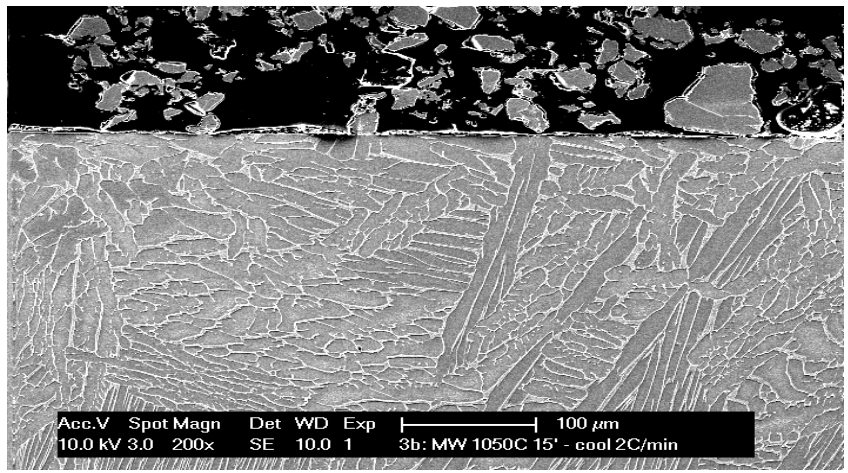
Ti6Al4V substrate after microwave sintering at 1050°C

o Effect of cooling rate





Fast cooling: fine lamellar



Slow cooling: coarse lamellar

Conclusion

- **Titanium coating by EPD of Ti particle stabilized emulsions with thickness of ± 200 µm with 70% open pores (50 µm)**

- **Coating consolidation by means of microwave heating with formation of Widmanstätten structure**

Any Questions?