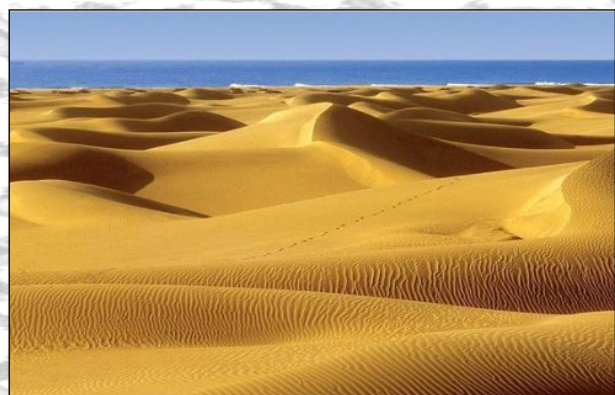


MECHANICAL PROPERTIES AND CORROSION RESISTANCE OF TWO NEW TITANIUM ALLOYS FOR ORTHOPAEDICS APPLICATIONS

Cristina Jiménez Marcos, MSc Student, University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain
Néstor Rubén Florido Suárez, Prof., University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain
Pedro Pablo Socorro Perdomo, Prof., University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain
Julia Claudia Mirza Rosca, Prof., University of Las Palmas de Gran Canaria, Las Palmas de Gran Canaria, Spain
Petrica Vizureanu, Prof., "Gheorghe Asachi" Technical University of Iasi, Romania

Department of Mechanical Engineering University of Las Palmas de Gran Canaria (ULPGC)





INDEX

1. INTRODUCTION
2. PURPOSE
3. EXPERIMENTAL
4. RESULTS
5. CONCLUSIONS

TITANIUM ALLOYS

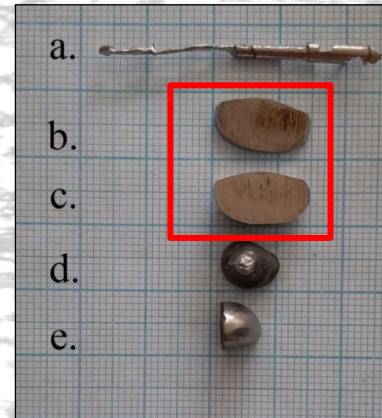
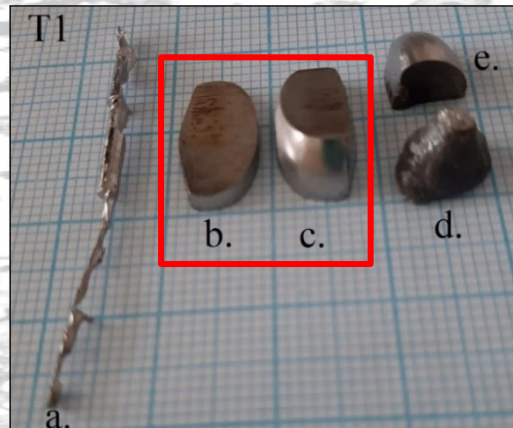
- Biomaterials used in this field are classified into three types:
 - Metals, such as stainless steel, titanium and CoCr alloys.
 - Ceramics, such as alumina (Al_2O_3) or hydroxyapatite.
 - Polymerics such as polylactic acid (PLA).
- Human hip supports 10 times a person's weight.
- Titanium phases:
 - α , β , $\alpha + \beta$.
- 1970 Titanium Alloy difficulties:
 - Aluminum \rightarrow Alzheimer and dementia.
 - Vanadium \rightarrow carcinogenic and a toxic element.
- Key features of the new alloys:
 - Low modulus of elasticity.
 - Low cytotoxicity.
- Previous research:
 - TiMo, TiMoZrTa, TiMoSi.



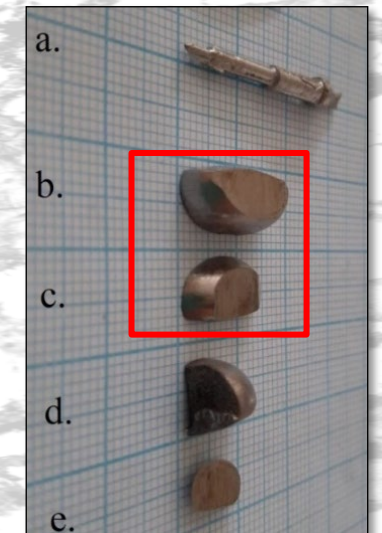
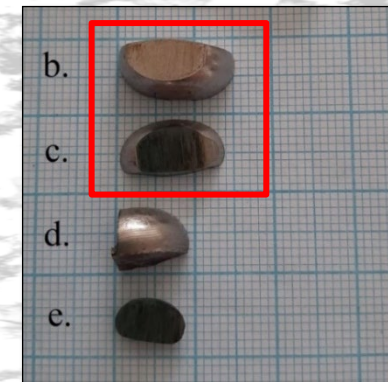
1. INTRODUCTION
2. PURPOSE
3. EXPERIMENTAL
4. RESULTS
5. CONCLUSIONS

TiMoZrXSi ALLOY

T1 (78% Ti, 20% Mo, 7% Zr, 0% Si)



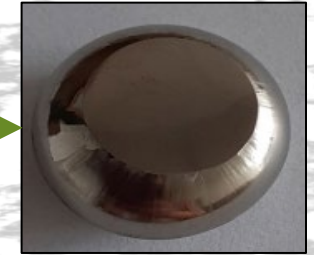
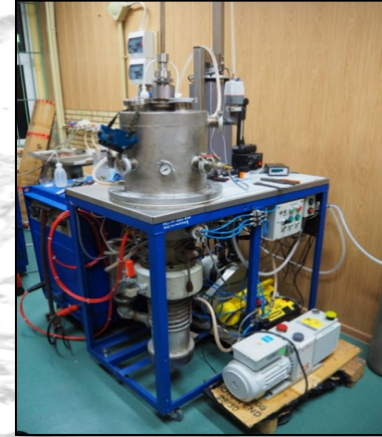
T2 (77% Ti, 20% Mo, 7% Zr, 1% Si)



1. INTRODUCTION
2. **PURPOSE**
3. EXPERIMENTAL
4. RESULTS
5. CONCLUSIONS

PREVIOUS STEPS

- Vacuum Arc Remelting (VAR).



- Encapsulating the samples.

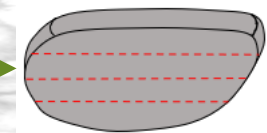
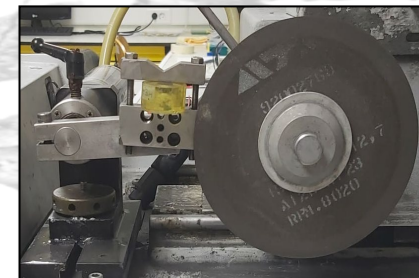
T1



T2



- Cutting the samples.

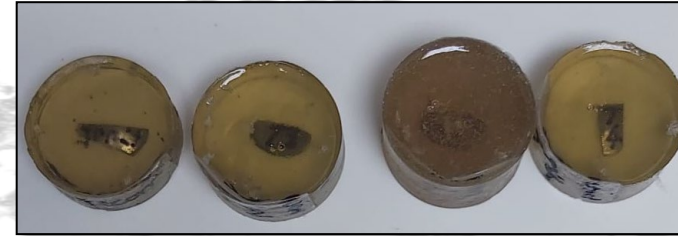


1st Cut
2nd Cut
3rd Cut

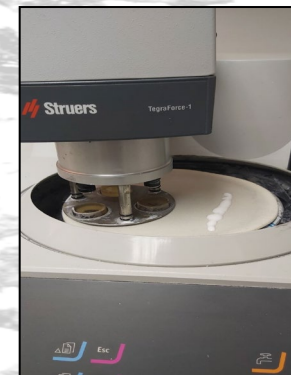


PREVIOUS STEPS

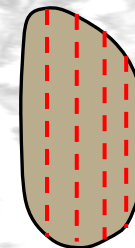
- Mounting the samples.



- Grinding and polishing.

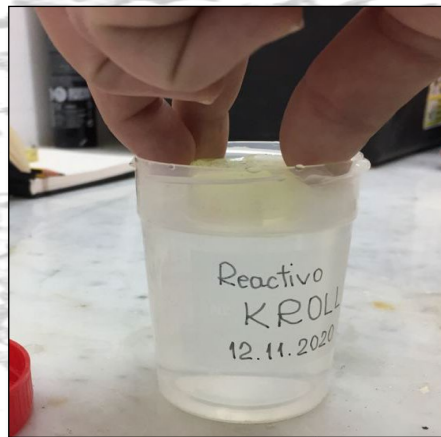


- Cutting the samples.



METALLOGRAPHIC TEST

- Chemical etching by Kroll reagent and microscopic analysis.



H₂O + HF + HNO₃

Attempts	T1	T2
1	15''	20''
2	25''	
3	35''	



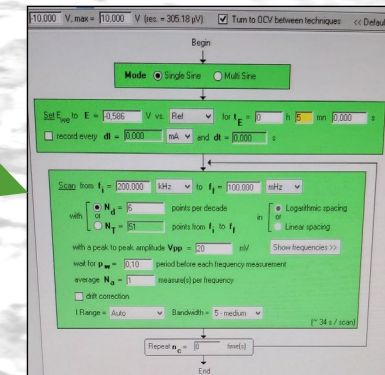
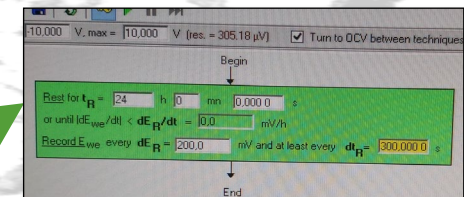
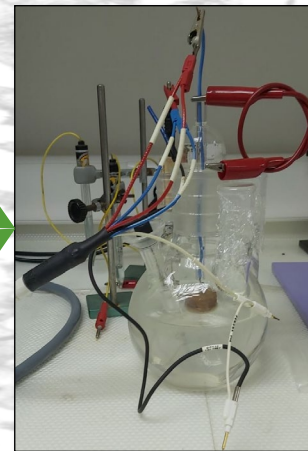
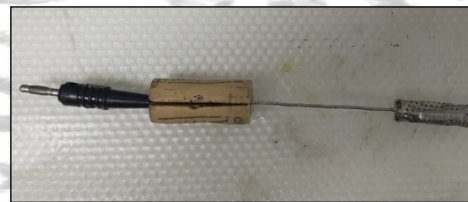
1. INTRODUCTION
2. PURPOSE
3. **EXPERIMENTAL**
4. RESULTS
5. CONCLUSIONS

ELECTROCHEMICAL TESTS

- Sample preparation.

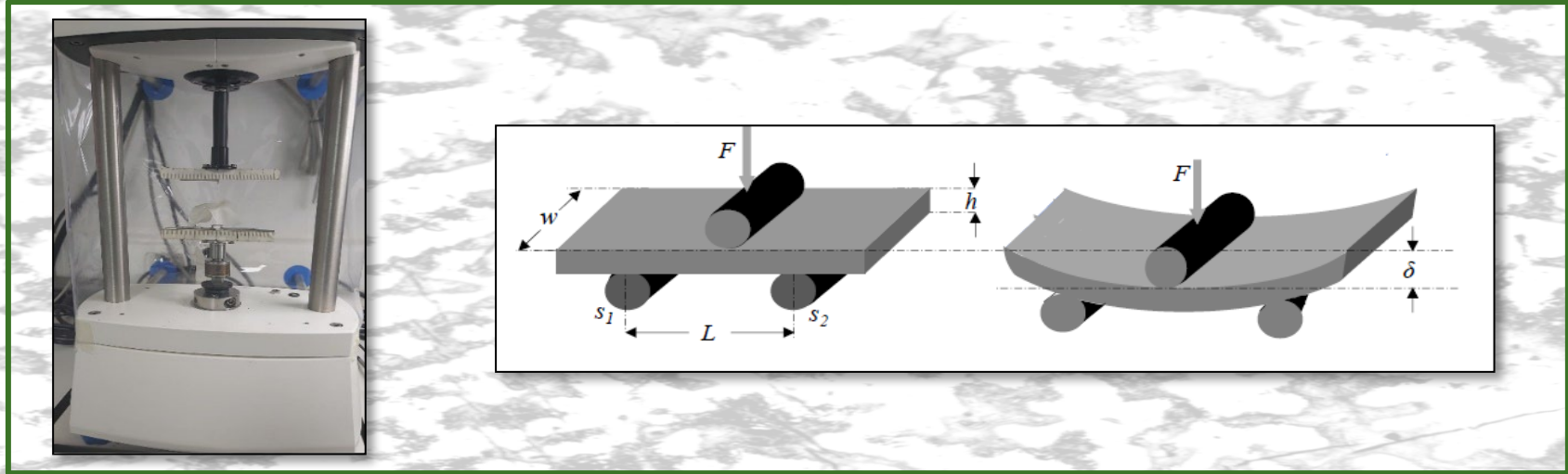


- Electrochemical cell.



1. INTRODUCTION
2. PURPOSE
3. EXPERIMENTAL
4. RESULTS
5. CONCLUSIONS

THREE-POINT BENDING AND MICROHARDNESS TESTS



1. INTRODUCTION
2. PURPOSE
3. **EXPERIMENTAL**
4. RESULTS
5. CONCLUSIONS



METALLOGRAPHIC TEST

T1

T2

Image without
attack x10

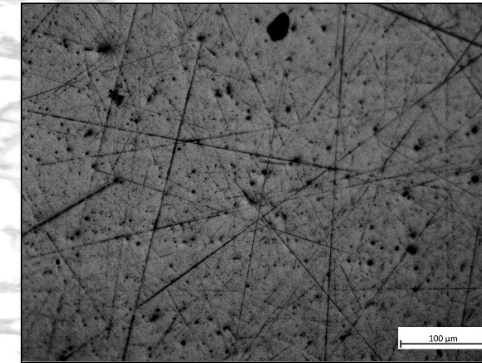
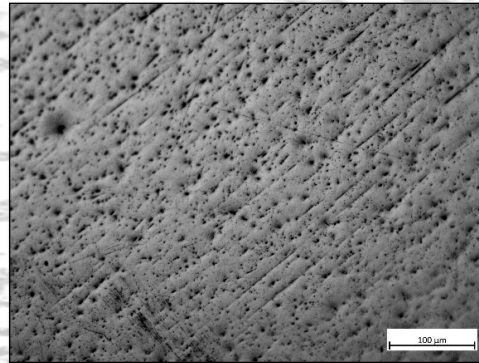


Image with
attack x10

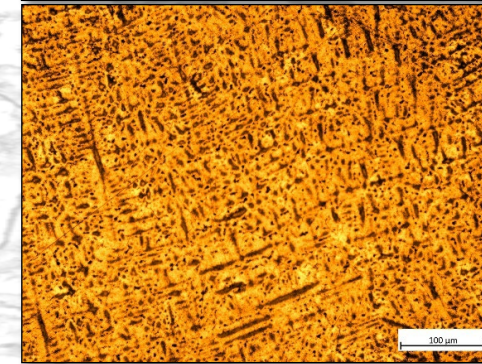
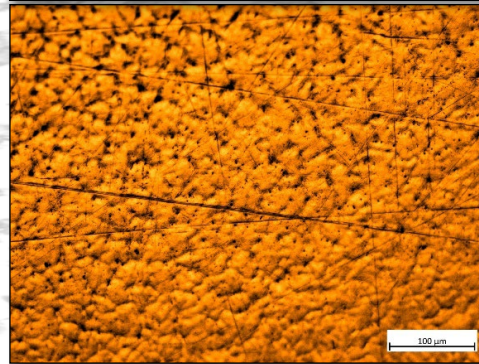
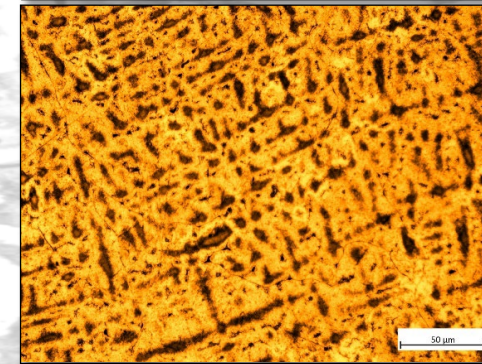
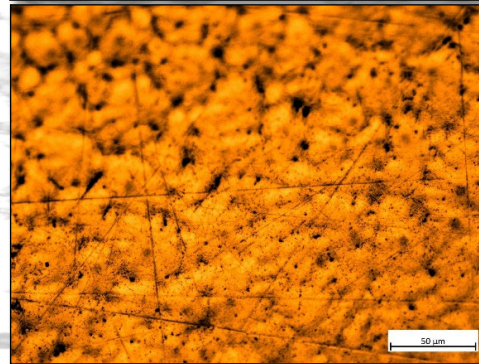


Image with
attack x20

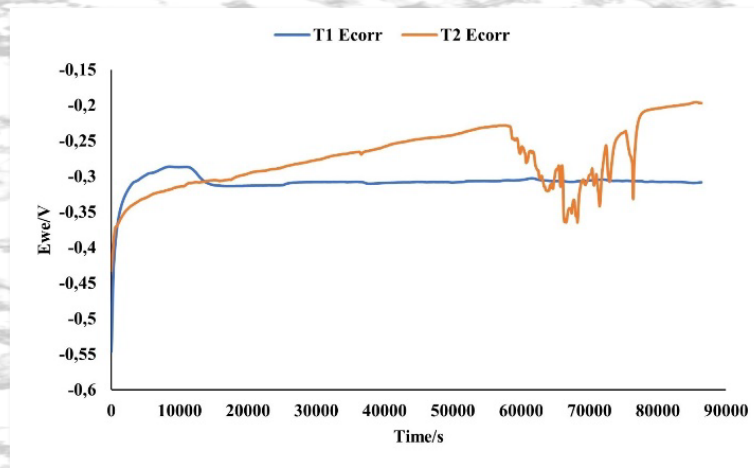


1. INTRODUCTION
2. PURPOSE
3. EXPERIMENTAL
4. RESULTS
5. CONCLUSIONS

ELECTROCHEMICAL TESTS

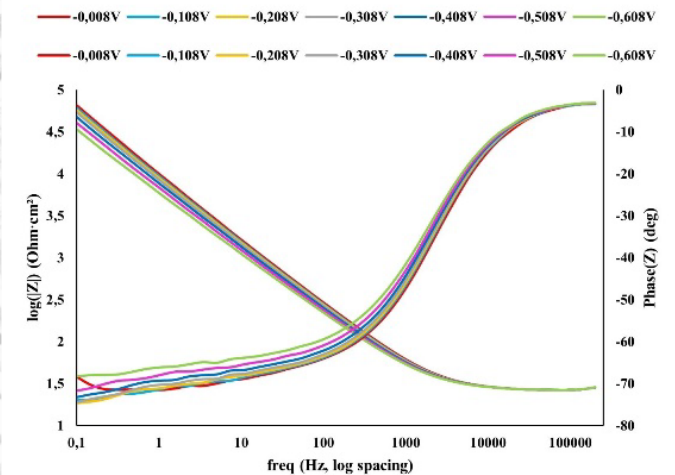
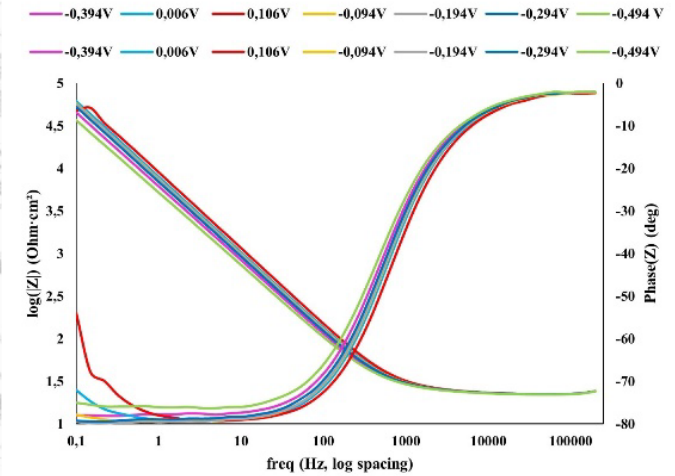
Electrochemical Impedance Spectroscopy (EIS)

Corrosion Potential



T1

T2



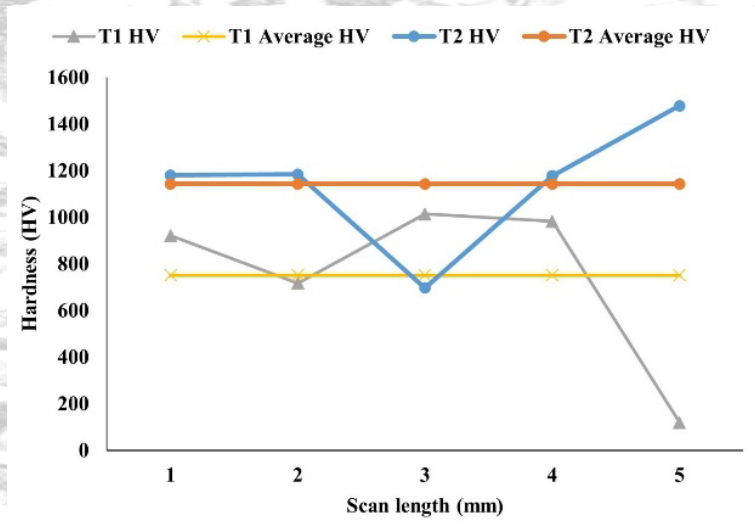
1. INTRODUCTION
2. PURPOSE
3. EXPERIMENTAL
4. RESULTS
5. CONCLUSIONS

THREE-POINT BENDING AND MICROHARDNESS TEST

	Sample	Length (mm)	Width (mm)	Thickness (mm)	Support spacing (mm)	E (GPa)
T1	T1.1	14.21	0.97	0.27	9.72	95.7891
	T1.2	14.42	0.99	0.19	9.72	81.3971
	T1.3	14.13	1.04	0.34	9.72	70.2292
T2	T2.1	13.26	2.37	0.36	7.80	65.3452
	T2.2	12.26	2.51	0.21	7.80	62.3137
	T2.3	12.87	2.46	0.22	7.80	81.0227

Other materials	E (GPa)
CoCrMo	210 – 253
Ti6Al4V	100 – 114
Human bone	17 – 30

1. INTRODUCTION
2. PURPOSE
3. EXPERIMENTAL
4. RESULTS
5. CONCLUSIONS



Alloys	Microhardness (HV)
CoCrMo	155 - 601
Ti6Al4V	349
T1 (78% Ti, 20% Mo, 7% Zr, 0% Si))	1014
T2 (77% Ti, 20% Mo, 7% Zr, 1% Si))	1478

CONCLUSIONS

METALLOGRAPHIC TEST



Two-phase structure of the T2 sample.

ELECTROCHEMICAL TESTS



Both samples tended to passivate and sample T1 offers slightly higher corrosion resistance.

THREE-POINT BENDING TEST



Low values of T2 (1% Si).

MICROHARDNESS TEST



Sample T2 has a higher Vickers Hardness value.

1. INTRODUCTION
2. PURPOSE
3. EXPERIMENTAL
4. RESULTS
5. **CONCLUSIONS**



THANK YOU FOR YOUR
ATTENTION!

