THE 9TH INTERNATIONAL CONFERENCE ON ADVANCED CONCEPTS IN MECHANICAL ENGINEERING

ACME – ADVANCED CONCEPTS in MECHANICAL ENGINEERING

"GHEORGHE ASACHI" TECHNICAL UNIVERSITY OF IAŞI - FACULTY OF MECHANICAL ENGINEERING

JUNE 04 - 05, 2020, IASI, Romania

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Topics

- Machine Design. Tribology. (Section 1);
- Materials and Surface Engineering (Section 2);
- Mechatronics. CAD. Mechanical Vibrations. (Section 3);
- Theory of Mechanisms and Machinery. Robotics (Section 4);
- Mechanics of Deformable Bodies (Section 5);
- Automotives. Engine and Transmission. Road Safety (Section 6);
- Applied Thermodynamics, Heat Transfer, and Renewable Energy. Thermal Systems (Section 7);
- Technologies in Agriculture and Food Processing (Section 8);

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FACULTY OF MECHANICAL ENGINEERING IASI

CONFERENCE PROGRAM

THE 9th INTERNATIONAL CONFERENCE ON ADVANCED CONCEPTS IN MECHANICAL ENGINEERING

ACME2020

JUNE 4 – 5, 2020
IAŞI, ROMANIA

Organized by:

FACULTY of MECHANICAL ENGINEERING

THE "GHEORGHE ASACHI" TECHNICAL UNIVERSITY OF IASI

Under the aegis of:

ROMANIAN MINISTRY OF NATIONAL EDUCATION AND SCIENTIFIC RESEACH
ROMANIAN ACADEMY OF TECHNICAL SCIENCES
ACADEMY OF ROMANIAN SCIENTISTS

In partnership with:

AMERICAN UNIVERSITY OF MADABA, JORDAN
SIAR - SOCIETY OF AUTOMOTIVE ENGINEERS OF ROMANIA
ARoTMM - ROMANIAN ASSOCIATION FOR MECHANISMS AND MACHINE SCIENCE
SROMECA – ROMANIAN ASSOCIATION OF MECHATRONICS
ART – ROMANIAN TRIBOLOGY ASSOCIATION
SRT - ROMANIAN SOCIETY OF THERMODYNAMICS
AFCR - ROMANIAN ASSOCIATION FOR REFRIGERATION AND CRYOGENICS ENGINEERS

5	2-10	**Morphological and tribological studies of thermal plasma jet deposited coatings used in cardan joints** A Dascălu, B Istrate, C Munteanu, C Paleu Cîrlan, V Paleu	13.00 - 13.15
		Own World Lunch Break	14.00 - 15.00
		POSTER SESSION	
6	2-01	**Analysis of the collapse mode classification in case of circular tubes** C P Predoiu, R F Negrea, S Tabacu, D Popa	15.00 - 15.10
7	2-02	**Ecological process for depositing thin layers with high tribology resistance for reconditioning the hydraulic turbines** C A Tugui, P Vizureanu, N A Danila, M C Perju, D P Burduhos-Nergis	15.10 - 15.20
8	2-04	**Experimental analysis of three tetra-anti-chiral auxetic honeycomb structures** R Negrea, P Predoiu, S Tabacu, D Negrea	15.20 - 15.30
9	2-06	**Fatigue cracks in aluminum alloys structures detection using electromagnetic sensors array** R Steigmann, N Iftimie, G S Dobrescu, A Danila, P D Barsanescu, M D Stanciu, A Savin	15.30 - 15.40
10	2-09	**Contact stress simulation problem in case of the Mg alloys** S Lupescu, C Munteanu, A Tufescu, B Istrate, N Basescu	15.50 - 16.00
11	2-11	**The study of the mechanism interaction between sparks electric discharges and a AISI 316L biocompatible metallic samples** A Piron, F V Anghelina, C Popa, V Despa	16.00 - 16.10
12	2-12	**Theoretical investigation of optical phenomenon from nanometric antireflex layers** A T Pascu, M A Pascu, D Besnea	16.10 - 16.20
13	2-13	**Experimental research and simulation of vibration isolation elements mounted within transport boxes** D Voicu, R M Stoica, R Vilau, L Barothi	16.20 - 16.30
14	2-14	**"In vivo" Analysis of Osteoinduction Treatment on Ti6Al7Nb** V Lucero Baldevenites, N Florido Suarez, P Socorro Perdomo, J Mirza Rosca	16.30 - 16.40
15	2-15	**Microscopic Passivation of Bio High Entropy Alloys: Initial studies** N Florido Suarez, V Lucero Baldevenites, P Socorro Perdomo, I Voiculescu, V Geanta, J Mirza Rosca	16.40 - 16.50
16	2-16	**Electrochemical Behavior of New Titanium Alloys** V Lucero Baldevenites, N Florido Suarez, P Socorro Perdomo, J	16.50 - 17.00

		Mirza Rosca	
17	2-17	**Nanostructurated Ti-20Zr in Artificial Extra-cellular Fluids** V Lucero Baldevenites, N Florido Suarez, P Socorro Perdomo, J Mirza Rosca	17.00 - 17.10

Session ACME-03-01: Mechatronics. CAD. Mechanical Vibrations

Thursday, June 4th, 2020

Chairmen: *Prof. Jose MACHADO* and *Lecturer Vlad CARLESCU*

No.	ACME code	Title of the papers and authors	Hours
1	03-01	**Experimental analysis of vertical vibration of railway bogie** M Dumitriu, I C Cruceanu	12.00 - 12.15
2	03-03	**Designing and testing a stand used to simulate the dummy head impact with different surfaces using CAD software** A I Radu, D D Truşcă, G R Toganel, B C Benea	12.15 - 12.30
3	03-04	**Bearing fault diagnosis using the Kolmogorov-Smirnov test on frequency features extracted using the Goertzel algorithm** D Cordoneanu	12.30 - 12.45
4	03-32	**Arduino based mobile robot controlled by voluntary eye-blinks using LabVIEW GUI & NeuroSky Mindwave Mobile Headset** O A Ruşanu, L Cristea, M C Luculescu	12.45 - 13.00
5	03-06	**Modelling and optimization of dynamic absorber with viscous friction** R Ibănescu, M Ibănescu	13.00 - 13.15
6	03-08	**Determinations regarding the influence of the different elastic systems from the suspension structure of a N2 type vehicle, on the movement and comfort** M F Mitroi, A Chiru	13.15 - 13.30
7	03-12	**Student demonstrator for teaching Brain-Computer Interfaces** A Ianoşi-Andreeva-Dimitrova, D S Mândru, I D Bologa	13.30 - 13.45
8	03-25	**Design, tuning and evaluation of a stand-alone nitinol based thermomechanical actuator driver with a closed-loop position control system** N Popescu	13.45 - 14.00
		Own World Lunch Break	14.00 - 15.00

Nanostructured Ti-20Zr in Artificial Extra-cellular Fluids

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Abstract. In response to concerns of potential cytotoxicity and adverse tissue reactions caused by vanadium and aluminium in the currently used biomaterial Ti-6Al-4V, the Ti–20Zr alloy was evaluated because it has been suggested as a candidate for human body implant material. The Ti-20Zr samples were machined and embedded in a resin and etched in Kroll´s reagent for microscopic observation. The microstructure and microhardness were tested. The electrochemical behaviour has been evaluated in simulated body fluid (SBF) using Electrochemical Impedance Spectroscopy technique (EIS). From metallographic images can be observed that the sample has an alpha-beta structure. From microhardness measurements can be concluded that the alloy formed a hard layer on its surface, which greatly improves the wear resistance. The electrochemical behaviour demonstrates that Ti-20Zr alloy exhibits excellent corrosion resistance due to the stable oxide layer formed on the surface. It has been demonstrated that Zr offers superior corrosion resistance over most other metals. The Ti-20Zr alloy exhibits an excellent corrosion resistance, better than cpTi and taking into account that there is a general agreement that Zr compounds have no local or systemic toxic effects, we can conclude that Ti-20Zr can be a potential biomaterial for use as an artificial surgical implant.

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Keywords:

Titanium, zirconium, biomaterial, corrosion, microhardness

1. Introduction:

Relatively few metals are biocompatible and, therefore used for structural application in the body (e.g., implants for hip, knee, ankle, shoulder, wrist and finger); the principal metals used are: stainless steels, cobalt-based alloys and titanium-based alloys. This is due to their ability to bear significant loads, withstand fatigue loading and undergo plastic deformation prior to failure. Further studies have shown the release of both V and Al ions from the alloy might cause long-term health problems, such as peripheral neuropathy, osteomalacia and Alzheimer diseases [1,2].
Zirconium is similar to titanium in that an adherent, protective oxide film forms on its surface. As a result, zirconium is very resistant to corrosive attack and also exhibits the highest biocompatibility of all metals [3].
The purpose of the present investigation is to correlate the microstructure, microhardness and electrochemical behaviour of nanostructurated Ti-20Zr in artificial extra-cellular fluids for biomedical applications.

2. Experimental Part:

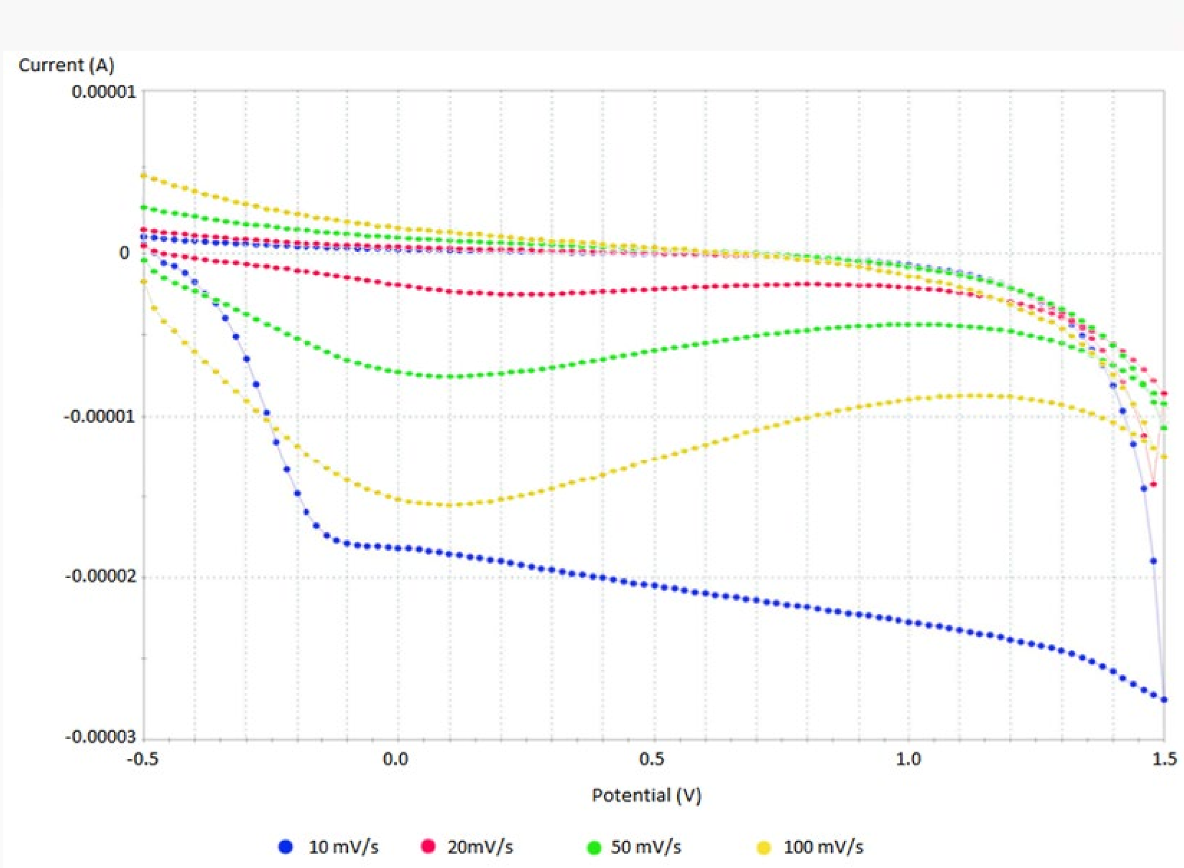
The Ti-20Zr alloy, composed of 80% Titanium and 20% Zirconium, (from R&D CS Bucharest, Romania – Research &Development Consulting and Services) was obtained by vacuum melting. Samples (Fig. 1) were prepared for each one of the different techniques: optical metallography, Vickers microhardness and Electrochemical Impedance Spectroscopy.
For microscopic observations, an Olympus PME 3-ADL microscope was employed. The surface was observed before etching and analysed at different magnifications.
The samples, ground and polished to mirror finish with alumina paste of 0.1 µm, were used to measure the microhardness by means of an indentation test (Remet HX-1000 Microhardness Tester).
Electrochemical measurements were made at 25ºC using a single compartmented cell containing 75 ml of electrolyte. The potential of the working electrode was measured against a NaCl (saturated) - calomel electrode (SSCE) and the mentioned potentials were referred to this electrode. A cylindrical Pt grid was used as a counter electrode.

3. Results and Discussions:

Fig. 1 shows the I-E profiles for Ti-20Zr alloy in Ringer's solution. The positive potential scan at 0.01 V/s runs from -0.5 V to 1.5V and did not show a cathodic current or anodic peaks.

The negative potential-going scan exhibits a cathodic peak at approximately -0.15 V. Current instabilities related to breakdown and repair events of the passive film are not detected and the returning scan does not exhibit a hysteresis loop, so the passive film has been fully restored (Fig. 1).

This behavior demonstrates that Ti-20Zr alloy exhibits excellent corrosion resistance due to the stable oxide layer formed on the surface. It has been demonstrated that Zr offers superior corrosion resistance over most other metals [4].



The obtained average values of microhardness permitted the calculation of the measurement depth. It was observed the presence of two phases: one soft and one hard and the correspondence values of microhardness are presented in the Table 1.
It can be seen that α phase is softer than β phase (around 30% less). The hardness of Ti-20Zr alloy is 1.2 times as large as that of commercially pure Ti, confirming the alloy's superior mechanical strength .
In Table 2 the approximate tensile strength is presented for the last three applied loads (50, 100 and 200 gf) using the average Vickers Hardness value.
The obtained tensile strength for Ti-20Zr is also superior to that of commercially pure Ti.

SOFT AND HARD PHASES - Ti-20Zr

LOAD (gf)	PHASE	HARDNESS (HV)	INDENTATION DEPTH (µm)
0.5	SOFT	37.3	0.712
	HARD	50.0	0.615
1	SOFT	66.2	0.756
	HARD	91.3	0.643
2	SOFT	101.5	0.863
	HARD	145.3	0.721
3	SOFT	127.7	0.942
	HARD	197.2	0.758
4	SOFT	149.8	1.000
	HARD	214.8	0.839
5	SOFT	163.7	1.075
	HARD	288.4	0.809
10	SOFT	194.6	1.394
	HARD	242.4	1.249
20	SOFT	201.9	1.935
	HARD	298.4	1.592
50	SOFT	212.8	2.981
	HARD	255.3	2.722
100	SOFT	201.3	4.335
	HARD	256.2	3.842
200	SOFT	210.5	5.990
	HARD	268.8	5.305

4. Conclusions:

The α + β microstructure obtained by aging at 1273 K for two hours exhibits a better mechanical biocompatibility, hence it is more suitable than the other microstructures for biomedical applications. These results confirm the data obtained with higher Zr content in Ti-based alloys.
The hardness of Ti-20Zr alloy is 20% higher than that of commercially pure Ti, confirming the alloy's superior mechanical strength.
The Ti-20Zr alloy exhibits an excellent corrosion resistance, better than cpTi and taking into account that there is a general agreement that Zr compounds have no local or systemic toxic effects, we can conclude that Ti-20Zr can be a potential biomaterial for use as an artificial surgical implant.

5. Acknowledgments:

We gratefully acknowledge the support and generosity of The R&D CS (Research & Development Consulting and Services) Bucharest, Romania, without which the present study could not have been completed.

References:

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