THE 9TH INTERNATIONAL CONFERENCE ON ADVANCED CONCEPTS IN MECHANICAL ENGINEERING

# ACME

ADVANCED CONCEPTS in MECHANICAL ENGINEEERING

"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

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# 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**<br>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**<br>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**<br>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**<br>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**<br>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**<br>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**<br>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**<br>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**<br>D Voicu, R M Stoica, R Vilau, L Barothi | 16.20 - 16.30 |
| 14 | 2-14 | **“In vivo” Analysis of Osteoinduction Treatment on Ti6Al7Nb**<br>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**<br>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**<br>V Lucero Baldevenites, N Florido Suarez, P Socorro Perdomo, J | 16.50 - 17.00 |

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|---|---|---|---|
| | | Mirza Rosca | |
| 17 | 2-17 | **Nanostructurated Ti-20Zr in Artificial Extra-cellular Fluids**<br>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**<br>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**<br>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**<br>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**<br>O A Ruşanu, L Cristea, M C Luculescu | 12.45 - 13.00 |
| 5 | 03-06 | **Modelling and optimization of dynamic absorber with viscous friction**<br>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**<br>M F Mitroi, A Chiru | 13.15 - 13.30 |
| 7 | 03-12 | **Student demonstrator for teaching Brain-Computer Interfaces**<br>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**<br>N Popescu | 13.45 - 14.00 |
| | | | |
| | | **Own World Lunch Break** | 14.00 - 15.00 |

# Electrochemical Behavior of New Titanium Alloys

**V. Lucero Baldevenites[1], N. Florido Suárez[2], P. Socorro Perdomo[1], J. Mirza Rosca[1]**

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**Abstract.** The attractive properties of titanium alloys as biomaterials were a driving force for the early introduction of Ti and Ti-6Al-4V as implantable materials. More recently, titanium-tantalum binary alloys have been developed and are expected to become promising candidates for medical applications due firstly, to alloying with tantalum, which is a non-toxic element, and secondly, due to their better compatibility with bone tissue than cp-Ti and Ti-6Al-4V alloy. The studied titanium tantalum alloys were Ti-5Ta, Ti-15, Ti-25Ta and Ti-30Ta obtained by levitation melting in a high-frequency induction furnace with a cold copper crucible, followed by a homogenization heat treatment in order to eliminate the segregation. The influence of potential on passive film of Ti-Ta alloys under simulated physiological conditions was investigated by different electrochemical techniques in direct current and by Electrochemical Impedance Spectroscopy (EIS) in alternative current. All measurements were carried out in Ringer solution at 25ºC and at different potentials starting at -0.4V till +2V. The influence of the alloying element, tantalum, is reflected, mainly, in an increasing oxide resistance and growth rate (especially for the Ti-25Ta alloy). The EIS technique is a powerful method to characterize the influence of the alloying elements on Ti behaviour.

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June 04-05, 2020,
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# Electrochemical Behavior of New Titanium Alloys

Las Palmas de Gran Canaria
España

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## Keywords:

Titanium, tantalum, corrosion, Ringer solution, medical devices.

## 1. Introduction:

Increased use of Ti and Ti alloys as biomaterials is occurring due to their lower modulus, superior biocompatibility and high corrosion resistance compared with conventional biomaterials such as stainless steel and Co-Cr alloys. These attractive properties were a driving force for the early introduction of Ti and Ti-6Al-4V as implantable materials [1]. But Ti-6Al-4V has a potential toxicity and adverse tissue reactions [2,3] and new Ti alloys composed of non-toxic and non-allergic elements have been developed for biomedical applications [4]. Among them, titanium-tantalum binary alloys have [5,6] been developed and, in this work, corrosion resistance of Ti-Ta alloys was tested by open-circuit potential measurements, linear polarization, potentiodynamic polarization and Electrochemical Impedance Spectroscopy.

## 2. Experimental Part:

The studied titanium tantalum alloys were Ti-5Ta, Ti-15Ta, Ti-25Ta and Ti-30Ta from R&D CS (Research & Development Consulting and Services) Bucharest, Romania. The Ti-Ta ingots (diameter = 20 mm, length = 30 mm) were obtained by levitation melting in a high-frequency induction furnace with a cold copper crucible, followed by a homogenization heat treatment in order to eliminate the segregation.
A conventional three-electrode electrochemical cell with a Pt grid as counter electrode and saturated calomel electrode (SCE) as reference electrode was used. AC impedance data were obtained at different potentials using a PAR 2634 A potentiostat connected with a PAR 5210 lock-in amplifier. The amplitude of the AC potential was 10 mV and single sine wave measurements at frequencies between 10-1 and 105 Hz were performed for each sample. In order to characterize the oxide film, the impedance spectra were recorded between -400 mV and 2000 mV with a 100 mV step, polarizing the electrodes continuously and allowing the system to stabilize for 600 s at each potential. Data acquisition and analysis were performed with a personal computer and the spectra were interpreted using the ZSimpWin program.

## 3. Results and Discussions:

The electric potential difference between electrolyte and metal interface is a relevant factor directly related to the surface conditions. The EIS tests have been carried out at different applied potentials in 3 domains: cathodic-anodic transition, passive and near transpassive transition. The impedance data will be compared in order to evaluate the influence of the potential on the passive oxide characteristics (see Fig.1).

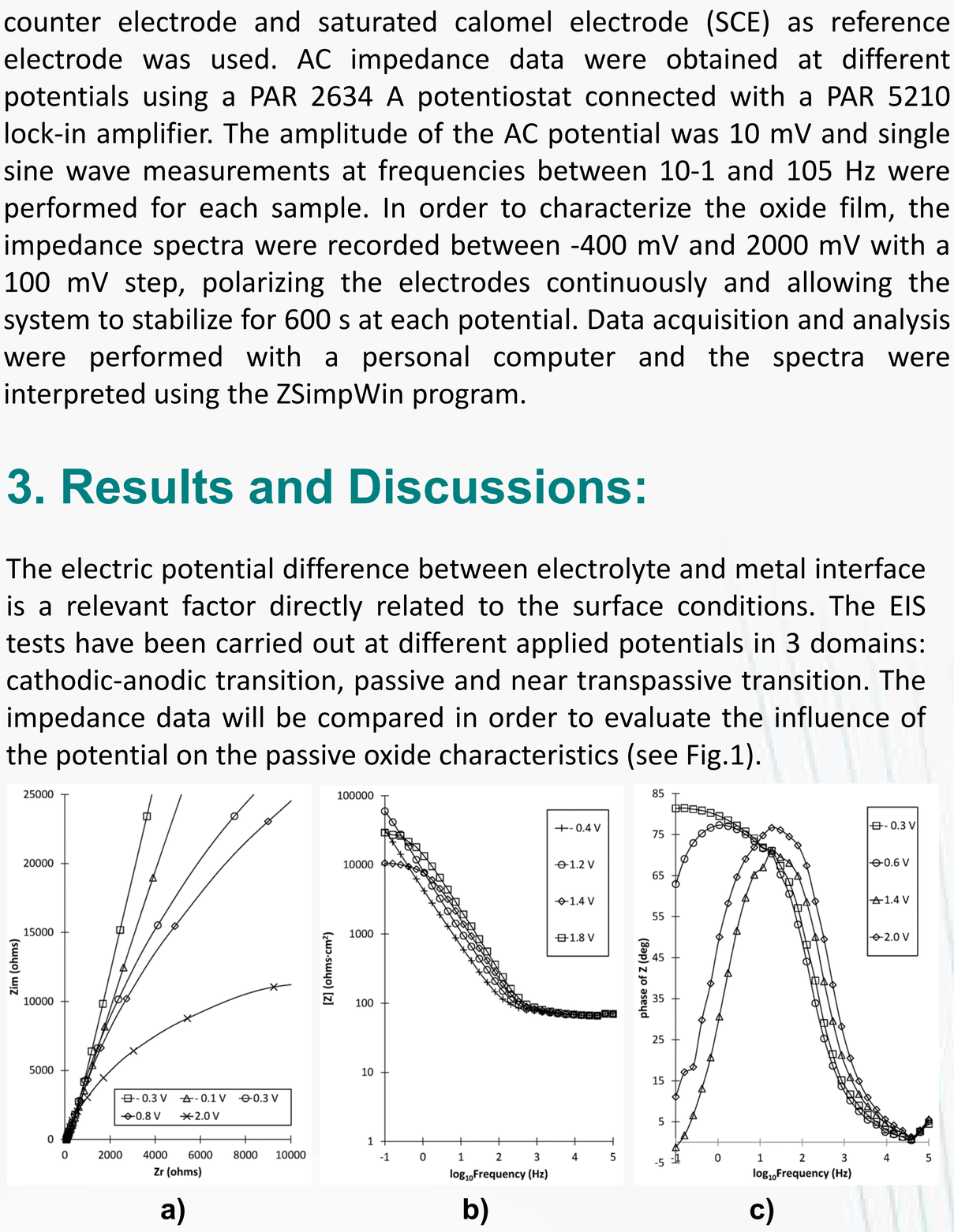
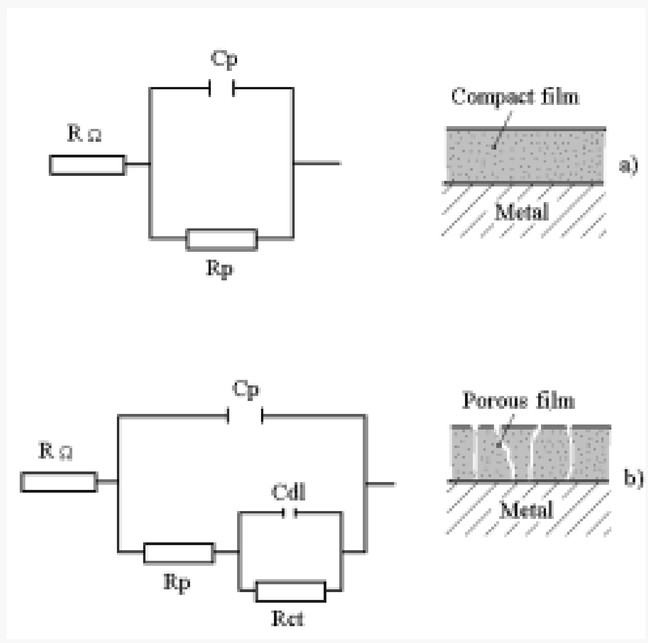



**Figure 1.** EIS curves for Ti-15Ta:a) Nyquist, b) Bode IZI and c) Bode phase

Analysis of the impedance spectra was done by fitting these data with ZSimpWin. The quality of fitting to the equivalent circuit was judged firstly by the chi-square value and secondly by comparing experimental with simulated data.
Instead of capacitance, constant phase elements CPE (which represent the deviation from the true capacitive behavior) were used.

Diagnostic criteria for the choice of equivalent circuits for modeling impedance data may be summarized by visual observations of the shifts in experimental Bode plots with changing potential and alloying element(see Fig.2).




## 4. Conclusions:

Among Ti-Ta alloys, the Ti-25Ta exhibits superior properties of the passive film and corrosion behavior, therefore it appears to be a promising candidate for metallic biomaterials.

Impedance spectra are fitted with one time constant equivalent circuit, typically for a compact oxide film, for all Ti-Ta alloys in extra-cellular fluids. The Nyquist plots for all the Ti-Ta alloys show the same incomplete semicircles with large diameters increasing with the potential (till a determinated value for each alloy) due to the improvement of the protective properties of the passive film formed on the surface of the alloy.

The passive layer resistance decreases with the potential due to the dissolution processes through the passive film. For all Ti-Ta alloys, the Bode phase plots exhibited one phase angle, typical for a capacitive barrier passive layer formed on the surface of the alloy.

Titanium-tantalum binary alloys are expected to become promising candidates for medical applications due firstly to tantalum which is a non-toxic element and secondly, due to their better compatibility with bone tissue compared with cp-Ti and Ti-6Al-4V alloy.

## 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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