# III INTERNATIONAL SCIENTIFIC CONFERENCE SUMMER SESSION

# 18 - 21 JUNE 2018, VARNA, BULGARIA

ISSN (Print) - 2535-0153 ISSN (Online) - 2535-0161



 $(\mathbf{r})$ 



# ORGANIZER SCIENTIFIC-TECHNICAL UNION of MECHANICAL ENGINEERING "INDUSTRY 4.0"





Year II

# Volume 1/3

**JUNE 2018** 

# ISSN (Print) - 2535-0153 ISSN (Online) - 2535-0161

## THEMATIC FIELDS <u>TECHNOLOGICAL BASIS OF "INDUSTRY 4.0"</u> DOMINANT TECHNOLOGIES IN "INDUSTRY 4.0"

BUSINESS & "INDUSTRY 4.0" SOCIETY & "INDUSTRY 4.0"

# ORGANIZER SCIENTIFIC-TECHNICAL UNION OF MECHANICAL ENGINEERING "INDUSTRY 4.0"

108 Rakovski str., 1000 Sofia e-mail: office@industry-4.eu www.industry-4.eu

## INTERNATIONAL EDITORIAL BOARD

| Co-Chairs:  |  |       |  |  |  |
|---|--|-------|--|--|--|
| Prof. D.Sc. Georgi Popov, DHC, Prof. Dr. Dr. Jivka Ovtcharova, DHC, |  |       |  |  |  |
| Technical University of Sofia, BG                                   | Karlsruhe Institute of Technology, GE                    |       |  |  |  |
| Members:  |  |       |  |  |  |
| Acad. Igor Bychkov  | Institute for System Dynamics and Control Theory SB RAS  |       |  |  |  |
| Cor. member Alexey Beliy  | National Academy of Sciences of Belarus                  |       |  |  |  |
| Cor. member Svetozar Margenov                                       | Bulgarian Academy of Science                             |       |  |  |  |
| Prof. Alexander Afanasyev   | Institute for Information Transmission Problems          |       |  |  |  |
| Prof. Alexander Guts  | Omsk State University                                    |       |  |  |  |
| Prof. Andrzej Golabczak   | Technical University of Lodz                             | PL    |  |  |  |
| Prof. Andrey Firsov   | Saint-Petersburg Polytechnic University                  | RU    |  |  |  |
| Prof. Bobek Shukley   | Ss. Cyril and Methodius University of Skopie             | MK    |  |  |  |
| Prof. Boris Gordon  | Tallinn University of Technology                         | EE    |  |  |  |
| Prof Branko Sirok   | University of Liubliana                                  | SI    |  |  |  |
| Prof. Claudio Melchiorri  | University of Bologna                                    |       |  |  |  |
| Prof Cveta Martinovska  | Goce Delchey University Stin                             | MK    |  |  |  |
| Prof. Dale Dzemydiene   | Mykolas Romeris University Vilnius                       | IT    |  |  |  |
| Prof. Dimitar Vonchay   | Free Bulgarian University, Villius                       | BG    |  |  |  |
| Prof. Dimitrios Vlachos   | Aristotla University of Thesseloniki                     | GP    |  |  |  |
| Prof. Calina Nikalahaya   | Tashnical University of Serie                            |       |  |  |  |
| Prof. Canand Lange  | Netional University of Solia                             |       |  |  |  |
| Prof. Gerard Lyons  | National University of Ireland, Galway                   |       |  |  |  |
| Prof. Giovanni Pappalettera   | Technical University of Bari, Italy                      |       |  |  |  |
| Prof. Henrik Carlsen  | Technical University of Denmark                          | DK    |  |  |  |
| Prof. Idilia Bachkova   | University of Chemical Technology and Metallurgy         | BG    |  |  |  |
| Prof. Idit Avrahami   | Ariel Univerity  | IL    |  |  |  |
| Prof. Iurii Bazhal  | National University of Kyiv-Mohyla Academy               | UA    |  |  |  |
| Prof. Jürgen Köbler   | University of Offenburg                                  | DE    |  |  |  |
| Prof. Jiri Maryska  | Technical University of Liberec                          | CZ    |  |  |  |
| Prof. Katia Vutova  | Institute of electronics, Bulgarian Academy of Sciences  |       |  |  |  |
| Prof. Lappalainen Kauko   | University of Oulo                                       | FI    |  |  |  |
| Dr. Liviu Jalba   | SEEC Manufuture Program                                  | RO    |  |  |  |
| Prof. Luigi del Re  | Johannes Kepler University, Linz                         | AT    |  |  |  |
| Prof. Majid Zamani  | Technical University of Munich                           | DE    |  |  |  |
| Prof. Martin Eigner   | Technical University of Kaiserslautern                   | DE    |  |  |  |
| Prof. Michael Valasek   | Czech Technical University in Prague                     | CZ    |  |  |  |
| Prof. Milija Suknovic   | University of Belgrade                                   | RS    |  |  |  |
| Prof. Miodrag Dashic  | University of Belgrade                                   | RS    |  |  |  |
| Prof. Mladen Velev  | Technical University of Sofia                            | BG    |  |  |  |
| Prof. Murat Alanyali  | TOBB University of Economics and Technology              | TR    |  |  |  |
| Prof. Nina Bijedic  | Dzemal Bijedic University of Mostar                      | BA    |  |  |  |
| Prof Ninoslav Marina  | University of Information Science and Technology - Ohrid | MK    |  |  |  |
| Prof. Olga Zaborovskaja   | State Inst. of Econom. Finance, Law and Technologies     | RU    |  |  |  |
| Prof. Pavel Kovach  | University of Novi Sad                                   | RS    |  |  |  |
| Prof. Peter Koley   | University of Transport Sofia                            | BG    |  |  |  |
| Prof. Peter Korondi   | Budanest University of Technology and Economics          | HU    |  |  |  |
| Prof. Peter Sincek  | Technical University of Košica                           | SV SV |  |  |  |
| Prof Petra Bittrich   | Berlin University of Annlied Sciences                    | CE    |  |  |  |
| Prof. Prodreg Desig   | High Tashnical Mashanical School Tratanik                | DE    |  |  |  |
| Prof. Padu Dogoru   | High Technical Mechanical School, Trstenik               |       |  |  |  |
| Prof. Radu Dogaru   | Tashai ash University of Caluster                        | RO    |  |  |  |
| Prof. Raicho Harionov   | Technical University of Gabrovo                          | BG    |  |  |  |
| Prof. Raul Turmanidze   | Georgian Technical University                            | GE    |  |  |  |
| Prof. Rene Beigang  | Technical University of Kaiserslautern                   | DE    |  |  |  |
| Prof. Rozeta Miho   | Polytechnic University of Tirana                         | AL    |  |  |  |
| Prof. Sasho Guergov   | Technical University of Sofia                            | BG    |  |  |  |
| Prof. Seniye Umit Oktay Firat                                       | Marmara University, Istambul                             | TR    |  |  |  |
| Prof. Sreten Savicevic  | University of Montenegro                                 | ME    |  |  |  |
| Prof. Stefan Stefanov   | Technical University of Sofia                            | BG    |  |  |  |
| Prof. Svetan Ratchev  | University of Nottingham                                 | UK    |  |  |  |
| Prof. Sveto Svetkovski  | St. Cyril and St. Methodius University of Skopje         | MK    |  |  |  |
| Prof. Tomislav Šarić  | University of Osijek                                     | HR    |  |  |  |
| Prof. Vasile Cartofeanu   | Technical University of Moldova                          | MD    |  |  |  |
| Prof. Vidosav Majstorovic   | Technical University of Belgrade                         | RS    |  |  |  |
| Prof. Vjaceslavs Bobrovs  | Riga Technical University                                | LV    |  |  |  |
| Prof. Inocentiu Maniu   | Politehnica University of Timisoara                      |       |  |  |  |
| DiplKfm. Michael Grethler   | Karlsruhe Institute of Technology                        | DE    |  |  |  |

## **CONTENTS**

## TECHNOLOGICAL BASIS OF "INDUSTRY 4.0". DOMINANT TECHNOLOGIES IN "INDUSTRY 4.0"

| INDUSTRY 4.0: REQUIRED PERSONNEL COMPETENCES<br>Panos Fitsilis1, Paraskevi Tsoutsa, Vassilis Gerogiannis  |
|---|
| APPLICATION OF ARTIFICIAL INTELLIGENCE FOR THE IMPLEMENTATION OF INDUSTRY 4.0 CONCEPT<br>prof. Dr. Ing. Kuric I., Ing. Zajačko I., PhD., Ing. Císar M., PhD., Tomáš Gál   |
| A COMPARISON OF SEQUENTIAL QUALITY CONTROL METHODS<br>Prof. Gurevich G., Mrs. Zohar L   |
| ANALYTIC SOLUTION OF A NONSTATIONARY EQUATION OF KOLMOGOROV-FELLER TYPE WITH A NONLINEAR  |
| Prof. Dr. Tech. Sci. Andrei N. Firsov   |
| COMPLEX SYSTEM, UTILITY AND DECISION CONTROL: A RISK PORTFOLIO OPTIMIZATION CASE<br>Prof. M.Sc. PavlovY. PhD., Prof.M.Sc. AndreevR. PhD   |
| SECURE AND EFFICIENT CLOUD COMPUTING ENVIRONMENT<br>Dr. PhD Associate Professor Chaikovska M. , Chaykovskyy O   |
| ANALYTICAL AND NUMERICAL ASPECTS OF THE SOLUTION OF THE PROBLEM OF A VISCOUS WEAKLY<br>COMPRESSIBLE LIQUID MIXTURE MOTION THROUGH THE VERTICAL PIPE OF THE CIRCULAR CROSS-SECTION<br>Asst., MSc Sorokina Natalia  |
| SOLID BODY SURFACING MATHEMATICAL MODEL IN STRATIFIED INCOMPRESSIBLE FLUID UNDER THE ACTION<br>OF BUOYANCY FORCE AND LIMITED MOTION CONTROL   |
| Prof., Dr. Tech. Sci. Firsov A.N., Postgraduate Kuznetcova L.V  |
| EFFECT OF TREATMENT TEMPERATURE OF TiO2/SiO2 AND ZrO2/SiO2 COATINGS ON THEIR CORROSION<br>STABILITY<br>Assist. Prof. St. Yordanov PhD., Assoc. Prof. I. Stambolova PhD, Assoc. Prof. V. Blaskov PhD, Prof. L. Lakov PhD, Prof. S. Vassilev PhD,<br>Asst Y. Kostova, M. Assoc. Prof. B.Jivov PhD |
| SEDIMENT RECYCLE AFTER BIODIESEL PRODUCTION<br>Sofronkov A.N. Professor, Doctor of Engineering Science; Vasilyeva M.G. Senior Lector  |
| WELDING OF GRADE 1 TITANIUM BY HOLLOW CATHODE ARC DISCHARGE IN VACUUM<br>Assos. Prof. PhD. Gospodinov D. D., Assist. Prof. PhD. Ferdinandov N. V., Assist. Prof. PhD. Ilieva M. D., Assos. Prof. PhD. Radev R. H.,<br>Mag. Eng. Dimitrov St. P  |
| FORMATION OF THE VULCANIZATION STRUCTURE OF THE ELASTOMERIC MIXTURES WITH THE PRESENCE OF   |
| Associate Prof. PhD eng. Tzolo Tzolov, PhD eng. Aleksandar Stoyanov, Mas.deg.eng.Margarita Trencheva  |
| <b>ELECTRICITY GENERATION BY MEANS OF MICROORGANISMS FROM DIFFERENT PHYSIOLOGICAL GROUPS</b><br>Marina Nicolova, Stoyan Groudev, Irena Spasova, Veneta Groudeva, Plamen Georgiev  |
| MOLD DESIGN AND PRODUCTION BY USING ADDITIVE MANUFACTURING (AM) - PRESENT STATUS AND FUTURE<br>PERSPECTIVES   |
| Ognen Tuteski M.Sc., Atanas Kočov, PhD  |
| PECULIARITIES OF CHEMICAL-THERMAL TREATMENT OF SEMI-PERMEABLE POWDER METALLURGICAL<br>MATERIALS IN SEMI-PERMEABLE SATURATION MEDIA<br>Assoc Prof. Mitev, I., Ph.D; M.Sn. Vinev, I   |
| МОДЕЛЬНО-АЛГОРИТМИЧЕСКАЯ ПЛАТФОРМА ДЛЯ УПРАВЛЕНИЯ ТЕПЛОВЫМ БАЛАНСОМ<br>АЛЮМИНИЕВОГО ЭЛЕКТРОЛИЗЕРА<br>Dr. Eng. Biskgshovg T.V., Bostgraduate Portwarkin A.A.   |
| DI. DIE. I ISRADIOVA I. V., I OSIGIAUUAIC I ORYAIIKII A.A   |

| GENETIC MODELING AND STRUCTURAL SYNTHESIS OF CNC MULTI-SPINDLE AUTOMATIC MACHINES OF NEW |    |
|--|----|
| GENERATION   |    |
| Prof. Dr. Eng. Kuznietsov Y., Ph.D. Gaidaienko Iu 5                                      | 57 |

### BUSINESS & "INDUSTRY 4.0". SOCIETY & "INDUSTRY 4.0"

| ECONOMIC ASPECTS OF THE DEVELOPMENT OF INFORMATION AND COMMUNICATION TECHNOLOGIES IN UKRAINE                                   |      |
|--|------|
| Doctor of Economic Sciences, Professor, Zhavoronkova G., PhD (Economics), Associate Professor, Zhavoronkov V., PhD (Economics) |      |
| Associate Professor, Klymenko V.   | 67   |
| FORMING THE POTENTIAL OF SCIENTIFIC KNOWLEDGE IN APPLIED SCIENTIFIC ORGANIZATIONS  | 71   |
|  | . /1 |
| OPPORTUNITIES OF IMPLEMENTATION OF "INDUSTRY 4.0" FOR DEVELOPMENT OF TRANSPORT INDUSTRY IN<br>UK BAINE                         |      |
| Assoc. Prof. Alieksieiev V. PhD., Dr. Dovhan V. PhD., Prof. Alieksieiev I. D.Sc.   | 75   |
|  |      |
| DISTINCTIVE FEATURES OF "SCIENCE-INTENSIVE PRODUCTS" AS INNOVATIVE WITH ESPECIALLY HIGH<br>PROPERTIES                          |      |
| Prof. Dr. Elena Yrevna Sidorova  | 78   |
|  |      |
| SERVICE SIMULATION IN INDUSTRY 4.0: A COMPARISON OF SIMULATORS   |      |
| Tsoutsa P. M.Sc., Professor Fitsilis P. PhD., Assistant Professor Ragos O. PhD.  | 81   |
|  |      |
| MACHINE OPERATION RESEARCH - PRODUCT AND MACHINE DATA INTEGRATION  |      |
| DiplIng. DiplKfm.(FH) Arndt S. G., DiplIng. Klement S., DrIng. Saske, B., Prof. DrIng. habil. Stelzer R. H.                    | 85   |
| COVEDNANCE OF INDUSTRIE 4.0. CONTRIBUTION TO THE DISCUSSION  |      |
| PhD Assistant Professor Renata Śliwa   | 89   |
|  | 07   |
| GEOMARKETING IS AN INNOVATIVE TECHNOLOGY BUSINESS  |      |
| Melnyk L., PhD (Economics), Associate Professor, Nyzhnyk L., graduate student  | 93   |
|  |      |
| FEASIBILITY STUDY FOR THE IMPLEMENTATION OF EDI SYSTEMS FOR INFORMATION EXCHANGE BETWEEN                                       |      |
| BULGARIAN BLACK SEA PORTS AND ECONOMIC OPERATORS   | 06   |
| Senior Assistant Prof. varbanova A. PhD  | 96   |
| САМООРГАНИЗАНИЯ И ТРАНСЛИСНИПЛИНАРНЫЙ ПОЛХОЛ В ПРОЕКТИРОВАНИИ СИСТЕМ   |      |
| Sorjko E., Doctor of Science, , As. Prof. Yegorova-Gudkova T,  | 100  |
| v  |      |
| АВАРИИНА ДИАГНОСТИКА И РЕМОНТ НА МАШИНИ И СЪОРЪЖЕНИЯ В ЛЕКАТА ПРОМИШЛЕНОСТ   | 104  |
| инж. мартин жотев  | 104  |
| RADIATION PROTECTION TRAINING AT VASIL LEVSKI NMU AND NRU "MOSCOW POWER ENGINEERING  |      |
| Chief Assistant Professor PhD eng. Dolchinkov N. T., Acos, Prof. PhD Hyostova M. S.  | 108  |
|  |      |
| EXPLORATION OF THE RADIOECOLOGICAL STATUS OF THE DRINKING AREA OF VELIKO TARNOVO   |      |
| Chief Assistant Professor PhD eng. Dolchinkov N. T.  | 111  |

#### SEDIMENT RECYCLE AFTER BIODIESEL PRODUCTION

### ПЕРЕРАБОТКА ОСАДКОВ, ОБРАЗУЮЩИХСЯ ПОСЛЕ ПОЛУЧЕНИЯ БИОДИЗЕЛЯ

Sofronkov A.N. Professor, Doctor of Engineering Science; Vasilyeva M.G. Senior Lector

#### Odessa State Ecological University. Odessa, Ukraine.

a\_sofronkov@ukr.net

razmargo@ukr.net

Table 1

The EU's energy policy is to increase the energy of renewable sources to 15% by 2020 with the production of biodiesel being ~ 7% of the total energy produced. In the field of transport energy supply the EU policy is to support the reduction of polluting gases emissions.

In 2014 biodiesel production amounted to 3.0 billion liters worldwide,  $\sim 90\%$  of which was produced in Europe. The production and use of biodiesel in Germany has increased significantly due to tax exemption. This was facilitated by the established wide network of filling stations (1500).

It should be taken into account that biofuel is 1.5 times cheaper than gasoline and when biofuel is burned, just as much carbon dioxide ( $CO_2$ ) is released into the atmosphere as absorbed by its plants which are its raw materials.

Table 1 shows the total amount of energy consumed when using various types of fuel.

Total amount of energy consumed when using various types of fuel (million tons).

| Fuel     | 1990  | 2000  | 2010  | 2020  | 2030  |
|----------|-------|-------|-------|-------|-------|
|          |       |       |       |       |       |
| Gasoline | 132,0 | 130,0 | 142,0 | 145,0 | 141,0 |
|          |       |       |       |       |       |
| Kerosene | 29,0  | 45,0  | 53,0  | 63,0  | 72,0  |
|          |       |       |       |       |       |
| Diesel   | 103,0 | 148,0 | 182,0 | 208,0 | 224,0 |

However, waste remained after biodiesel production pollutes the environment [1]. The process of production is represented in the scheme.



The purpose of this research is to develop a technology for processing residues remained after biodiesel production in order to reduce environmental pollution.

The material of the research is the sediment remained at factories after biofuel production.

The object was initially examined chromatographically in order to establish the composition of sediment formed after biofuel production [2]. Sediment electro-oxidation was carried out in a conventional glass cell with a separated cathode and anode space in a 7M solution of potassium hydroxide (KOH) at various electrodes (Pt, Ni-Re, Ni<sub>2</sub>B, Co<sub>2</sub>B, Fe<sub>2</sub>B) at different temperatures and sediment concentrations at the Sistem-500 potentiostat. The potential was measured relative to the mercury oxide reference electrode [3]. The degree of oxidation was judged not only by the polarization curves obtained, but also by the position and magnitude of the peaks in the IR spectra taken before and after the sediment oxidation. The substances obtained again after electrooxidation were identified using various physicochemical methods of UV, IR spectroscopy [4-6]. The sediment composition studied with a chromatograph is shown in Table 2.

#### Table 2

| N/N | Substance        | Sediment | Sediment | Sediment |  |
|-----|------------------|----------|----------|----------|--|
|     |                  | fraction | fraction | fraction |  |
| 1   | Glycerin         | 83,60    |          |          |  |
|     |                  |          | 97,80    | 95,00    |  |
| 2   | Esters of        | 0,10     |          |          |  |
|     | methyl acids C-  |          | 0,15     | 0,10     |  |
|     | 16:0             |          |          |          |  |
| 3   | Esters of        | 0,40     | -        |          |  |
|     | methyl acids C-  |          |          | -        |  |
|     | 16:0             |          |          |          |  |
| 4   | Acids C-16:0     | 0,10     |          |          |  |
|     |                  |          | 0,10     | 0,08     |  |
| 5   | Acids C-18:N     | -        |          |          |  |
|     |                  |          | 0,40     | 0,35     |  |
| 6   | Ester of methyl  | -        |          | -        |  |
|     | acid C-22:0      |          | 0,06     |          |  |
| 7   | Monoglyceride    |          |          |          |  |
|     |                  | 4,50     | 0,20     | 2,00     |  |
| 8   | Ester of methyl  |          |          |          |  |
|     | acid C-18:0      | 4,50     | -        | 2,50     |  |
| 9   | $\sum$ Esters of |          |          |          |  |
|     | methyl acid C-   | 2,20     | 2,00     | 0,20     |  |
|     | 18:1+2+3         |          |          |          |  |
| 10  | $\sum$ Esters of |          |          |          |  |
|     | methyl acid C-   | 0,60     | -        | -        |  |
|     | 18:N             |          |          |          |  |

The composition of the researched sediment obtained during biodiesel production at various factories

As can be seen at the table above, the composition of sediment obtained at various factories differs insignificantly. The polarization curves obtained at sediment electro-oxidation when producing biodiesel are presented in Fig. 1.



Puc 1. The polarization curves obtained at sediment electrooxidation after biodiesel production: 1- smooth Ni; 2- Fe<sub>2</sub>B; 3- Co<sub>2</sub>B; 4- Ni<sub>2</sub>B; 5- Ni-Re (303K); 6- Ni-Re (323K)

As can be seen at the figure, sediment electro-oxidation obtained in biofuel production increases for all the researched catalysts electrodes (Pt, Ni-Re, Ni<sub>2</sub>B, Co<sub>2</sub>B, Fe<sub>2</sub>B) with increasing temperature and concentration in the alkaline solution (7M KOH), which is not unexpected. The potential of the working electrode was established in 3-5 minutes and was reproduced quite well while shifting into the field of large potentials with the researched sediment concentration increase. The maximum current density achieved on smooth platinum is ~ 10 mA / cm<sup>2</sup> at the potential of 0.3 V.

The researched catalysts (Pt, Ni-Re, Ni<sub>2</sub>B, Co<sub>2</sub>B, Fe<sub>2</sub>B) were studied by X-ray diffraction analysis on unfiltered Fe<sub> $\kappa\alpha$ </sub>

radiation ( $\lambda_{Fe}$  = 1,93 Angstrom). The URS-60 apparatus (the "powder" method, the Debye camera) was used for the X-ray check.

The Raney alloy was obtained by adding powdered nickel to the aluminum melt followed by cooling in air to room temperature. The alloy was then crushed to a powdery condition. The alloy leaching was carried out during a day in a 20% sodium hydroxide solution (NaOH). The content was then transferred to a stainless steel container and placed on a water bath for 8 hours. After the mentioned time the mother liquor was drained, the alloy was poured with a fresh 30% solution, placed in an autoclave, heated to a temperature of 353-363 K. The autoclave was cooled to a room temperature, the resulting alloy was washed with a 10% NaOH solution 3-5 times and then with distilled water to pH = 7. The resulting catalyst was stored in ethyl alcohol solution [7].

Borides of variable valence metals (Ni<sub>2</sub>B, Co<sub>2</sub>B, Fe<sub>2</sub>B) were electrochemically obtained by using an electrolyte of the following composition: NiCl<sub>2</sub>· 6· H<sub>2</sub>O (AR) - 120 g/l; NaBH<sub>4</sub> - 5g/l; NaOH - 40 g/l; Rochelle salt - 50 g/l; The bath temperature is 333 K; sedimentation time - 20 min. To slow down the hydrolysis reaction a strong alkaline medium pH>12 was used.  $6Ni^{2+}$ + 5 BH<sub>4</sub><sup>-</sup>+  $6H_2O$ +7e  $\rightarrow$  3 Ni<sub>2</sub>B + 2B(OH)<sub>3</sub> + 13 H<sub>2</sub>

To establish the phase composition of the obtained borides not only X-ray phase analysis was used but the amount of boron was also determined. For that purpose the films were dissolved in "royal vodka" and boron was determined by the method [8].

Calculation of interplanar distances was carried out according to the Wolf-Brag formula [9]

 $2d \sin \Theta = n\lambda$ 

The catalyst dispersion was carried out according to the Selyakov-Scherrer formula [10].

The crystal lattices parameters were calculated from quadratic forms for various syngonies (cubic, tetragonal, hexagonal) [11]. The results of the calculations are presented in Table 3.

| Parameters of crystal lattice in the Ni-Re alloy |  |                   |  |                   |                   |                  |
|--|--|-------------------|--|-------------------|-------------------|------------------|
| Phase  | Parameters of erystal lattice<br>phases crystal lattice in<br>the equilibrium<br>condition |                   | Parameters of the<br>crystal lattice<br>in the Ni-Re alloy |                   |                   |                  |
|  | a, A <sup>0</sup>  | b, A <sup>0</sup> | c,A <sup>0</sup>   | a, A <sup>0</sup> | b, A <sup>0</sup> | c,A <sup>0</sup> |
| Ni Al <sub>3</sub>                               | 6,611  | 4,812             | 7,366  | 6,650             | 4,770             | 7,390            |
| Ni <sub>2</sub> Al <sub>3</sub>                  | 4,028  | 4,89              | -  | 4,045             | 4,855             | -                |
| Ni Al  | 2,887  | -                 | -  | 2,872             | -                 | -                |
| Ni <sub>2</sub> B                                | -  | -                 | -  | 4,985             | -                 | 4,253            |
| Co <sub>2</sub> B                                | -  | -                 | -  | 5,027             | -                 | 4,222            |
| Fe <sub>2</sub> B                                | -  | -                 | -  | 5,110             | -                 | 4,250            |

 Table 3

 Parameters of crystal lattice in the Ni-Re allo

It is known that the catalytic activity of variable valency metal alloys depends not only on the nature and size of the catalyst surface but also on the d-characteristic surface [12].

There is a relationship between the d-characteristic, the number of electrons (z) above the argon shell and the radius of the single bond (R).

 $R = 1,825-0,043z-(1,6-0,1z) \delta 10^{-2}$ 

There is another formula that expresses the relationship between single bond radius and fractional bond index (the ratio of valency to the coordination number)  $R = R_n + 0.3 \text{ lg n}$ 

So for  $\delta$  we get:

 $\delta = (1,825 \cdot R_n - 0,3 \lg n \cdot 0,043z) : (1,6 \cdot 0,1 z);$ 

The change in the crystal lattice parameter due to impurities introduction and the carrier nature will lead to a change in the catalytic activity, which we observe as a more complete

SPECORD """

Fig. 2a



Fig. 2b



As can be seen at the obtained spectra electro-oxidation shows significant changes in the wave number range of  $2800-1550 \text{ cm}^{-1}$  and  $1550 - 650 \text{ cm}^{-1}$ .



The obtained reaction products can be identified as: I-1,3dihydroxypropanol (dihydroxyacetone), II-2-oxo, 3hydroxypropanoic acid (hydroxyhydric acid), III-2-oxopropanedioic acid (mesoxalic acid) - a component of lotions, emulsifiers, creams to intensify tanning, catalyst for the synthesis of esters.

This reaction was studied [13], nickel (I and II) and palladium applied to coal (III) were used as a catalyst. The sediment oxidation formed in the biofuel production on Ni-Re rather than on borides of variable valency metals.

To confirm the possibility of sediment electro-oxidation, production and identification of electro-oxidation products formed after biofuel production in alkaline electrolyte, an "Specord" IR spectrometer was used. Typical IR spectra of sediment oxidized on Ni-Re are shown in Fig. 2a, b

Sediment electro-oxidation can be represented by the following scheme

borides allowed to increase the yield of the reaction product. This research resulted in developing a technique for recycling waste generated in the biodiesel production.

It shows the possibility of a more complete electrooxidation of generated waste using Ni - Re catalysts and a transition metal boride (Me<sub>2</sub>B)

use of other catalysts, Raney nickel (Ni-Re) and Me2B

#### REFERENCES

1. Statistic in focus – Agriculture and fisheries – 3/2006. European Communities. 2006 p. p. 6.

2. Porzinskiy S., Yankovskiy M., Berman A. [Fundamentals of chromatography applications in catalysis.] Moscow: MIR, 2006. 560 p.

3. K. Vetter. Elektrochemicsche kimtik. Berlin, Gottingen, Heidelberg, 1961. 856 p.

4. Kozitsina L.A., Kupletskaya N.B., [Application of UV, IR and NMR spectroscopy in organic chemistry.] Moscow: Vysshaya shkola, 1971. 264 p.

5. Ioffe B.V., Kostikov R.R., Razin V.V. [Physical methods of determining the structure of organic molecules.] Leningrad: Leningrad university publ., 1976. 344 p.

6. Sil`versteyn R., Bassler G., Morril T. [Spectrometric identification of organic compounds]. Moscow: MIR, 1977. 590 p.

7. Yusti E., Vinzel` A. [The fuel cells]. Moscow: MIR, 1964. 480 p.

8. Nemodruk A. A., Paley P.N., Hun-I, Factory Laboratory, 1962, T.28, 6.4. p. 406-408

9. [Guide to x-ray diffraction study of the moth crystals.] Leningrad: Neva, 1975. 218 p. (Ed.: V.A. Frank-Kamenetskyi)

10. Rusakov A.A. [Radiography of metals]. Moscow: Atomizdat, 1977. 212 p.

11. Mirkin L.I. [Handbook of x-ray diffraction analysis of metals]. Moscow: Phisics-Mathematics Literatures Publ., 1961. 863 p.

12. Davtyan O.K. [Kinetics and catalysis chemical and electrode processes]. Armyanskaya SSR Academy Sciences Publ., 1984. 383 p.

13. [Electrochemistry of organic compounds]. Moscow: MIR, 1976. 731 p. (Ed. M. Bayder).