

# **Advanced Materials and Processes of Metalworking**

Selected, peer reviewed papers from the  
IV International Science and Technical Conference  
METAL PHYSICS. Mechanics of Material  
and Deformation Processes  
(METALDEFORM-2015),  
September 14-17, 2015, Samara, Russia

*Edited by*

**Heinz Palkowski, Vladimir Yuhvid,  
Dmitriy Chernikov, Alexander Amosov,  
Fedor Grechnikov, Yuriy Klochkov,  
Ekaterina Nosova and Yaroslav Yerisov**



# Table of Contents

## Preface

v

## Chapter 1: Metal Physics and Mechanics of Deformation Processes

<b>Computer Analysis of Sinking Pass through one and Two Dies</b> B.V. Kargin.....	3
<b>Determination of One-Channel Press Dies Operating Corbels</b> V.R. Kargin and B.V. Kargin.....	7
<b>Testing Criterion Models of Destruction of Materials with Different Rheological Properties under Edge Cutting Machining</b> V.P. Alekseev and A.I. Khaimovich.....	13
<b>The Results Comparasion of Calculation Method and Computer Modeling of Double Curvature Sheet Shells in Stretch Forming Process</b> V.A. Mikheev and S.V. Surudin.....	21
<b>Influence of Temperature, Strain Rate, and Sheet Thickness on the Deformation Behaviour of Twin-Roll Cast, Rolled and Heat-Treated AZ31 under Uniaxial Loading</b> F. Berge, M. Wollschläger, C. Krbetschek and M. Ullmann.....	29
<b>Modeling the Hot Deformation Behavior of 1565ch Aluminum Alloy</b> S.V. Rushchits, E.V. Aryshensky, S.M. Sosedkov and A.M. Akhmed'yanov .....	35
<b>Property Oriented Wire Rolling Technology for Mg-Al Alloys</b> J. Dembińska, M. Graf, M. Ullmann, K. Neh, B. Awiszus and R. Kawalla.....	42
<b>The Parameters of the Stress State in the Operations of Plastic Deformation</b> E.N. Sosenushkin, V.A. Kadymov, E.A. Yanovskaya, A.A. Tatarencev and A.E. Sosenushkin .....	57
<b>Influence of Temperature and Loading Rate on the Forming Limit Behaviour of Twin-Roll Cast, Rolled and Heat-Treated AZ31 as a Function of the Stress State</b> F. Berge, T. Henseler, C. Krbetschek, M. Ullmann and R. Kawalla .....	67
<b>The Study of Plastic Deformation at High Strain Rates in Upset Forging of Cylinders</b> F.V. Grechnikov and A.I. Khaimovich.....	74
<b>Evaluation of Formability of Thin Sheet Metal from Mechanical Properties</b> S. Guk.....	80
<b>Influence of Deformation Conditions on the Microstructure and Formability of Sintered Mg-PSZ Reinforced TRIP-Matrix-Composites</b> S. Guk, D. Milisova and K. Pranke.....	86
<b>Material Flow in Mg-PSZ Particle Reinforced TRIP-Matrix-Composites due to Hot-Rolling</b> K. Pranke and S. Guk.....	97
<b>Bainitic Steels, their Characteristics and Applications</b> M. Shimanov, G. Korpala, A. Terzic and R. Kawalla .....	104

<b>Upgraded Railway Front Searchlight Design Plastic Deformations by its Vibrations with Resonance Frequencies</b>	
S.R. Abulkhanov and D.S. Goryainov .....	111
<b>Residual Stresses Control for Large Scale Open Die Forged Parts</b>	
M. Hardin and S. Burtsev.....	120
<b>Mathematical Model of Anisotropic Elastoplastic Material</b>	
Y.A. Erisov .....	127
<b>Virtual Material Model with the Given Crystallographic Orientation of the Structure</b>	
F.V. Grechnikov and Y.A. Erisov.....	134
<b>Isothermal Backward Extrusion of Thick-Walled Anisotropic Pipe Blanks in Mode of Short-Time Creeping</b>	
S.S. Yakovlev, A.A. Perepelkin and A.A. Pasyukov.....	143
<b>Combined Isothermal Drawing of Axisymmetrical Parts Made out of Anisotropic Materials in Mode of Short-Time Creeping</b>	
S.S. Yakovlev, O.V. Pilipenko and A.A. Pasyukov .....	152
<b>Technological Modes of Stretching Operation Involving Wall Thinning of Axisymmetric Blanks Made out of Anisotropic Materials</b>	
S.S. Yakovlev, M.V. Gryazev and V.Y. Travin .....	165
 <b>Chapter 2: Advanced and High-Energy Processes in Metal Pressure Working</b>	
<b>Development of the Combined Technology of Manufacturing of the Facilitated Constructions of Seal of an Electrocable</b>	
S.V. Nescoromniy, E.L. Strizhakov, S.O. Ageev and D.V. Rogozin .....	177
<b>Development of Methods and Research on High Voltage Capacitor Welding</b>	
S.V. Nescoromniy, S.O. Ageev and E.L. Strizhakov .....	185
<b>Formation of Hard Alloys of Chromium Carbide and Titanium Powder Mixtures by Explosive Pressing</b>	
V.O. Kharlamov, A.V. Krokhaliev, S.V. Kuz'min and V.I. Lysak .....	193
<b>The Wear-Resistance and Antifrictional Properties of Hard Alloys of Chromium Carbide with Titanium Produced by the Explosive Compaction of Powders</b>	
A.V. Krokhaliev, V.O. Kharlamov, M.A. Tupitsin, S.V. Kuz'min and V.I. Lysak .....	198
<b>Pressing Tubes with Conical-Stepped Needles Computer Simulating</b>	
F.V. Grechnikov, A.E. Afanasyev, V.R. Kargin and B.V. Kargin .....	204
<b>Characteristics of Large Bars Extruding Using Small Extrusion Ratio</b>	
V.R. Kargin and A.Y. Deryabin.....	211
<b>Development and Enhancement of Thin-Walled Tube Separation Methods</b>	
S.G. Simagina .....	218
<b>Determination of Rheological Properties of Titanium Alloys under Conditions of High Strain Rates</b>	
A.V. Balaykin, A.I. Kondratev and N.V. Galkina .....	222
<b>Computer Simulation of the Half-Tore Forming Process from a Ring Blank</b>	
I. Suleymanova, A. Shlyapugin and Y.A. Erisov .....	227

<b>Stamping of Hemispheric Surface Parts in Die Tool Equipped with Steel Elastic Element</b>	
E. Nesterenko .....	234
<b>The Forming Process of the Sharply Curved Offsets by the Pushing Method</b>	
V.D. Maslov, I.P. Popov and V.D. Misyura .....	242
<b>Directional Thickness Alteration of a Thin-Walled Ring Blank Using Flanging and Forming for the Purpose of Receiving Conical Part</b>	
E. Demyanenko and I.P. Popov .....	253
<b>Forming of Small-Diameter Tubes via Pulse-Magnetic Technology</b>	
D.G. Chernikov .....	263
<b>Application of Structural Inheritance Phenomenon at Producing the Al-Mg System Alloys</b>	
K.V. Nikitin, V.I. Nikitin and D.G. Chernikov .....	269
<b>Research of the Parts Pressing Process Using the Elastic Media Pressure</b>	
E.G. Gromova and E.V. Eskina .....	273
 <b>Chapter 3: Advanced Materials and Nanotechnologies</b>	
<b>Nanostructured Aluminum Matrix Composites of Al-10%TiC Obtained <i>In Situ</i> by the SHS Method in the Melt</b>	
A.P. Amosov, A.R. Luts and A.A. Ermoshkin .....	281
<b>A Review on <i>In Situ</i> Synthesis of Al/TiC and Al/SiC-Composites</b>	
H. Nath .....	287
<b>Stress-Corrosion Defects Fatigue Development in Compressor Station Output Gas Pipeline</b>	
I.V. Scherbo, S.A. Kholodkov, A.V. Afanasyev and M.I. Vaskov .....	293
<b>Fabrication of Al-AlN Nanocomposites</b>	
A.P. Amosov, Y.V. Titova, I.Y. Timoshkin and A.A. Kuzina .....	302
<b>Obtaining Nanopowder Pseudo-Ligatures Al-(SiC+Si<sub>3</sub>N<sub>4</sub>) for Modification of Aluminum Alloys</b>	
A.A. Kuzina and A.V. Kuts .....	310
<b>Recovery Technology Features of Aerospace Parts by Layering Synthesis</b>	
V.G. Smelov, A.V. Sotov and A.V. Agapovichev .....	316
<b>Metal-Polymer-Metal Laminates for Lightweight Application</b>	
H. Palkowski and A. Carradò .....	323
<b>Study of Stress Relaxation for 5056 Alloy in Vacuum Conditions</b>	
V.D. Yushin, V.I. Tregub and S.V. Voronin .....	335
<b>Research of the Microstructure and Mechanical Properties of Copper and CuZn36 Developing during Deformation into the Equal Channel Speed Matrix with High-Intensity Cooling</b>	
I.E. Volokitina, S.N. Lezhnev, E.P. Orlova and G.G. Kurapov .....	346
<b>SHS Metallurgy of NiAl-Based Alloy</b>	
V.I. Yukhvid, M.I. Alymov, V.N. Sanin and D.E. Andreev .....	353
<b>A New Method of Metallic Alloys Producing with Interphases, which are Formed Coherent Coupling of Compounds' Atoms</b>	
V.A. Mikheev and G.P. Doroshko .....	359

<b>Effect of Strain on the Anisotropy Coefficient of Sheet Alloys AA2024, Ti-2Al-1Mn, Titanium Grade 2, STEEL X10CrNiTi18-9</b>	
E.A. Nosova and F.V. Grechnikov .....	366
<b>Fabrication of Aluminum-Ceramic Composites with TiC-Ni Skeleton by SHS Pressing Method</b>	
A.F. Fedotov, E.I. Latukhin and V.A. Novikov .....	371
<b>Study of Possibility of Obtaining Nanopowder Composition of "Aluminum Nitride – Boron Nitride" by Azide SHS Technology</b>	
L. Shiganova, G. Bichurov, I. Kerson, V.A. Novikov and A.P. Amosov .....	379
<b>Characterization Analytic Method Specifying the Steel X10CRNITI18-10 Cylinder Surface Layer Quality Hardened by a Traveling Sphere</b>	
S.R. Abulkhanov, D.L. Skuratov and A.N. Shvetcov .....	387
<b>Influence of 3104 Alloy Microstructure on Sheet Performance in Ironing Aluminum Beverage Cans</b>	
A.V. Andrianov, E.G. Kandalova, E.V. Aryshensky and A.F. Grechnikova .....	398
 <b>Chapter 4: Tools and Machine Parts, Assurance of Materials Quality, Organization of Production</b>	
<b>Manufacturing Process Optimization at Enterprises</b>	
E.A. Matveeva and S.G. Simagina .....	409
<b>Constructional Materials Quality Management According to the Scanning Thermal Analyzer</b>	
V.A. Mikheev, G.P. Doroshko and V.N. Ilyukhin .....	414
<b>Efficiency Improvement of Metal Lathing by Using of an Evaluation Technique of Assembly Machine Tools Quality</b>	
D.S. Vasilega and M.S. Ostapenko .....	421
<b>An Industrial and Sociological Research of Consumers Requirements to a Lathing Tool</b>	
M.S. Ostapenko and D.S. Vasilega .....	429
<b>Enhancement of a Methodology of Assembly Lathing Tools Quality Evaluation</b>	
M.S. Ostapenko and A.M. Tveryakov .....	435
<b>Peculiarities of Quality Ensuring in Parts from Ti-Based Alloy VT6 with Ultrafine-Grained Structure</b>	
E.V. Safin and A.M. Smyslov .....	440
<b>Structural Strength of Materials as a Factor to Ensure the Quality of Machine Parts</b>	
E. Frolova, V. Trunov and T. Kuisokov .....	445
<b>Application of the Method of Performance Evaluation of the Production Process Design Using Associative Design</b>	
Y. Klochkov and A. Gazizulina .....	448
<b>Improvement of Methodology of Evaluation of Efficiency of the Metallurgical Complex Processes Development</b>	
Y. Klochkov and A. Gazizulina .....	453
<b>Quality Management of Metal Products Prepared by High-Speed Direct Laser Deposition Technology</b>	
V. Glukhov, G. Turichin, O. Klimova-Korsmik, E. Zemlyakov and K. Babkin .....	461

<b>The Quality Improvement in Manufacturing “Screw”-Parts Using the DEFORM-3D Software</b>	
S. Zvonov and A. Shlyapugin .....	468
<b>Development of FMEA Method with the Purpose of Quality Assessment of Can Stock Production</b>	
Y. Klochkov, A. Its and I. Vasilieva.....	473
<b>Mathematical Model and Program Development for the Efficient Process Conditions Determination during FeC0.15Cr12Ni2 Steel Diamond Smoothing</b>	
A.N. Shvetcov and D.L. Skuratov .....	477
<b>Testing of Thin-Walled Tubular Workpieces</b>	
S.G. Simagina .....	483
<b>Improvement of Technological Process of Multiproduct Production on the Bases of Simulation Modeling of Production Unit</b>	
I.N. Haimovich and M.A. Frolov .....	487
<b>Designing Forging and Die Tooling for the Manufacture of Turbine Engine Compressor Blades in Siemens NX</b>	
D.S. Goryainov, V.V. Anokhin and A. Shlyapugin.....	497
<b>Multi-Block and Multi-Station Pulse-Magnetic Installations</b>	
R.Y. Yusupov and V. Glushchenkov.....	507
<b>Pulse-Magnetic Processing of Materials - Development - Problems and Solution Techniques</b>	
V. Glushchenkov.....	511
<b>Problems of Realization of Static-Dynamic Technologies and Ways of their Solution</b>	
I. Belyaeva, R.Y. Yusupov and V. Glushchenkov.....	515
<b>Actuator from a Material with the High-Temperature Shape Memory Effect and Examples of its Application in Engineering</b>	
V. Glushchenkov, R.Y. Yusupov, V. Alekhina and Y. Egorov.....	523
<b>Design Features of the Small-Scale PMI Power Unit</b>	
E.E. Kostriukov and R.Y. Yusupov .....	530
<b>Keyword Index</b> .....	535
<b>Author Index</b> .....	541