

Table of Contents

Preface

Chapter 1: Additive Manufacturing

Determining the Optimal Mode of the Inconel 718 Alloy Deposition at a Direct Laser Deposition Plant M. Oleynik, A.I. Khaimovich and A.V. Balyakin	3
Modeling and Optimization of Additive Systems Based on Intelligent Technologies I. Lvovich, Y. Lvovich, A. Preobrazhenskiy, O. Choporov and E. Ružický	13
Influence of Surfacing Modes on the Formation of Pores in the Deposited Metal Produced by Wire Arc Additive Method (WAAM) Using Al-Mg Alloy A.I. Kurakin, I.G. Strukov, I.P. Skoblikov, V.M. Karpov and E.I. Efimov	20
Mortar for 3D Printing Based on Gypsum Binders E. Potapova, T. Guseva, K. Shchelchikov and H.B. Fischer	26
Measurement Assurance of Additive Manufacturing on the Example of Laser Surface Polishing Products by Remelting A.A. Kransutskaya, V.A. Funtikov, A.B. Syritskii and A.S. Komshin	32
Optimization of Temperature Regimes of the Hotend for Devices of Additive Manufacturing A.Y. Sinev, R.A. Panasenko, V.V. Petrenko, A.V. Berestov and Y.V. Bozhko	41
Stress Simulation of the Structure of a Stretch Die Made by Fused Deposition Modeling A.O. Koshkina, E.G. Karpukhin, A.V. Morozov and A.E. Abramov	47
Experimental Investigation of Nozzle Clogging Using Vibration Signal-Based Condition Monitoring for Fused Deposition Modeling D. Jhodkar, A. Nayak and K. Gupta	55
Cold Resistance and Mechanical Properties of 07Cr25Ni13 (ER309LSI) Stainless Steel Obtained by 3D Printing by Electric Arc Surfacing on a CNC Machine D.A. Shatagin, M.S. Anosov, P. Kolchin, D.A. Ryabov and A.V. Kiselev	65
Investigation of the Peculiarities of Deformation and Fracture of Metals Obtained on the Basis of 3D Printing with Registration of an Acoustic Emission Signal M.S. Anosov, Y.G. Kabaldin, D.A. Shatagin, D.A. Ryabov and P. Kolchin	71
Kinematic Error Modeling of Delta 3D Printer A.V. Kochetkov, T.N. Ivanova, L.V. Seliverstova and O.V. Zakharov	77
Towards the Possibility of Additive Manufacturing of XNA-Based Devices Using Molecular Engineering Principles O.V. Gradov, I.A. Maklakova, M.A. Gradova, A.I. Sergeev and Y.K. Naganovskiy	84
Sample Printing Device for Additive Manufacturing of Electronic Housings A.Y. Sinev, R.A. Panasenko, V.S. Shamkova, G.K. Baryshev and A.V. Berestov	105
Technology for Producing Fine Tungsten Carbide Powders K.M. Kolmakov and A.E. Zverovshchikov	111
Cyber-Physical Hybrid Processing System Digital Twin D.A. Shatagin, A. Galkin, A.N. Osmehin and N. Klochkova	119

Chapter 2: Polymers, Composites and Ceramics

The Structure and Properties of Dispersed Aluminium Composite Compounds Made by Welding Friction with Mixing A.N. Feofanov, V.V. Ovchinnikov and A.M. Gubin	127
Influence of Additive's Concentration on the Temperature Conditions for the Formation of the Solid Solutions of the System $\text{MgAl}_2\text{O}_4\text{-Ga}_2\text{O}_3$ A.V. Ulianova and M.O. Senina	135
Studies of Magnetically Active Silicone Elastomers on a Vibrostend A.J. Minaev, J. Korovkin, H.H. Valiev, G. Stepanov and D.Y. Borin	141

Comparative High-Field Magnetization Study of (Sm,Er)₂Fe₁₇ and Er₂Fe₁₇ Compounds and their Nitrides L.A. Ivanov, M. Paukov, I. Tereshina, S. Veselova, O.V. Akimova, V. Verbetsky and D.I. Gorbunov	148
Accelerated Weathering Testing of Polypropylene Tank Materials A.M. Suleymanov, E.B. Tuisina, L.N. Shafigullin, R. Rinberg and A.T. Gabdrakhmanov	154
Improvement of Thermal Conductivity for Carbon Fabric Composites Base on the Fabric Structure P.T. Kyaw, P.P. Maung and G.V. Malysheva	161
The Patterns of Phase Composition and Properties of High-Calcium Low-Density Ceramics Formation Based on Argillous Raw Materials of Various Chemical and Mineralogical Composition N. Yatsenko, A.I. Yatsenko, N.A. Vil'bitskaya, O.I. Sazonova and R.V. Savanchuk	167
Study of the Effect of Tungsten Carbide Nanopowder Agglomerate Additives on the Strength Properties of Carbon Fiber-Reinforced Plastic V.M. Gavrish, T. Chayka, A. Oleynik and O. Gavrish	174
Research on the Synthesis of Proppants Applied for Oil Production by the Method of Hydraulic Facing E.A. Yatsenko, B.M. Goltsman, A. Chumakov, N.A. Vil'bitskaya and W.S. Li	181
Creation of Basalt Plastics with Different Types of Hybrid Matrices E. Kosenko, N. Baurova and V. Zorin	189
New Technologies for Producing Multifunctional Reinforced Carbon Plastics V.A. Neluyb, G.V. Malysheva and I.A. Komarov	196
Features of Mechanical Treatment of Zirconia Crystals when Manufacturing Dies V. Alisin, M.A. Borik, A.V. Kulebyakin, E.E. Lomonova and D.M. Gutsev	203
Experience of High-Density Polyethylene as a Binding Substance in Grinding Wheels A. Korotkov, V.A. Korotkov, V. Fedorov and S. Vöth	209
Synthesis of a Composite Alloy Based on Ore Concentrate and Oxide Compounds E.D. Kim, E.H. Ri, M.A. Ermakov, H. Ri and A.S. Zhivetyev	218

Chapter 3: Metallurgical and Metalworking Technologies

Improvement of Method and Mechanism for Conical and Paraboloid Springs Hardening N.A. Zemlyanushnov and N.Y. Zemlyanushnova	227
Crimping Power Modes with Thinning of the Deformable Element of the Steel Pipe S.N. Larin, V.I. Platonov and O.A. Tkach	233
Optimization of Cutting Conditions with an End Mill According to the Criterion of the Smallest Amplitude of Vibration D.Y. Topolov and I.S. Boldyrev	239
Milling of Electron Beam Melting Ti-6Al-4V by HSS Instrument with Combined Surface Treatment S.V. Fedorov, T. Oo and E.S. Mustafaev	245
Residual Stresses Determination near FSW Joints by Combining the Hole Drilling Method and Reflection Hologram Interferometry A.V. Chernov, I.N. Odintsev and V.S. Pisarev	251
Controlled Process of Crystallization in Weld Pool V. Melyukov and E.A. Marinin	258
Investigation of Influence of Magneto-Hydrodynamic Processes on Structure Formation and Alloying of Steels by Electroslag Remelting E.N. Kuzmichev, P.V. Igumnov, V.K. Khe and A.E. Skiruta	264
Specific of the Recrystallization Driving Force Calculation on the early Stages of Thermomechanical Treatment of Aluminum Alloys E.V. Aryshenskii, J. Hirsch, E.D. Beglov, S. Kononov and V.R. Kargin	273
Drawing of Square Blanks in a Cylindrical Die with Controlled Movement of the Edges S.N. Larin and N.A. Samsonov	281
Science-Based Technologies in the Manufacture Liquid Rocket Engines Filter Element Channels A. Ryazantsev, A. Shirokozukhova and O. Shipilova	287

Isothermal Crimping of Thick-Walled Shells A.A. Pasynkov, S.V. Nedoshivin and N.S. Pasynkova	293
Research of the Influence of the Physical and Mechanical Properties of the Workpiece Material on the Temperature Field of the Turning Process A.N. Unyanin and P.R. Finageev	300
Modeling the Deformation of Non-Rigid Shafts during Turning on CNC Machines N.P. Matseyan and N.V. Nosov	309
Mathematical Modeling of Process Optimization in Profiling Grinding Wheels via Laser I.B. Sefedin and E. Yagyaev	315
Structural Features and Distribution of Silicon in Ferrosilicon-Magnesium Modifiers D. Boldyrev, S.I. Platov, M.V. Kharchenko and N.V. Urtsev	322
The Study of the Effect of Thermal Deformation Treatment Modes on the Microstructure and Properties of the Heat-Resistant Nickel Alloy VZH159 G.N. Gavrilov, V.V. Galkin, A.D. Ryabtsev, A.A. Generalov and E.O. Bazhenov	329
Investigation of the Effect of Hardening Heat Treatment Modes on the Properties of Products Made of Silicon-Nickel Bronze E.A. Marinin, D.G. Sergeev and A. Pogudina	335
Experimental and Computational Method for Determining Temperature Stresses in the Welding of Structures Made of Carbon and High-Alloy Structural Steels L. Mironova, R. Nigay and E. Nigay	343
Forecasting of the Possibility of Fragile Destruction Top of Cutting Blade of a Thread Forming Tool M.F. Selemeneyev, A.S. Tarapanov, L.Y. Frolenkova, A.D. Novikov and E.A. Prasolov	349
Experimental Studies of Deformation and Temperature Processes Mandrelling in the Deform-3D System M.F. Selemeneyev, A.A. Cherepenko, E.A. Zvyagina, A.N. Tkachenko and E.M. Selemeneyeva	357
Use of Digital Twins for Mathematical Modeling of Ultrasonic Cutting of Titanium Blanks M. Ilyushkin, K. Savelev, O. Krupennikov and E. Kiselev	369
Analytical Modeling of Cutting Forces and Technological Parameters Interrelation when Grinding Shafts' Ends by a Grinding Wheel End on Circular Grinding Machines S. Yudin, P. Pereverzev and B. Reshetnikov	377
The Correlation of Movements in the Technological System during Grinding Precise Holes S. Bratan, S. Roshchupkin and A. Chasovitina	384
Model of Layer-by-Layer Cooling Trajectory in Rolled Products by TMCP S.I. Platov, K.B. Maslennikov, N.V. Urtsev, R.R. Dema and E.Y. Zvyagina	390
Application of an Ultra-Compact Eddy-Current Transducer for Investigation of Defects in Welded Joints of High-Strength Steel V.N. Malikov, A.V. Ishkov and L. Nikonov	400
Diagrams of Isothermal Decomposition of Overcooled Austenite in Maraging Steel at Uniaxial Tensile Loading T.M. Makhneva, A.A. Sukhikh, V.B. Dementyev and S.S. Makarov	409

Chapter 4: Coatings and Surface Treatment

Research on Chrome Plating Quality of the Internal Surfaces in the Hydraulic Drives with Hydrostatic Guideways D.V. Ardashev, N. Yusubov, L.V. Shipulin and A. Degtyareva-Kashutina	417
Analysis of Phase Composition and Properties of Composite Nickel-Phosphoric Coatings Using Wear-Resistant and Antifriction Modifying Agents I.N. Shcherbakov	423
Study of the Influence of the Shape of Internal Cavities on the Nature of Wave Strain Hardening A.V. Kirichuk, S.V. Barinov and D.O. Umnov	429
Structure and Properties of a Local Diffusion Discrete Coating Applied to High Speed Steel E.A. Chekalova and A.V. Zhuravlev	435
The Study of the Formation Process of Microstructure and Properties during Laser Alloying of the Surface of the Structural Steels G.N. Gavrilov, E.A. Marinin, P.M. Yavtushenko, N.S. Uglov and K.V. Razheva	442

The Peculiarities of Mass Transfer in the Surface Layer of Materials under Extreme Heating	
A.V. Brover, G.I. Brover, O.B. Moysova and V.E. Yankovskaya	449
Production of Colored Phosphate Coatings on Steel	
V.S. Konovalova and V.E. Rumyantseva	457
Functional Gradient Heat-Resistant Materials Manufactured by Spark Plasma Sintering	
S.A. Oglezneva, M.N. Kachenjuk, A.A. Smetkin and V.V. Savich	464
Obtaining of Coatings from Ni-Al by Electro Spark Deposition and Surface Smoothing by Ultrasonic Plastic Deformation	
S.N. Khimukhin, K.P. Eremina and S.V. Nikolenko	473
Composition and Properties of High-Entropy CrZrTiNiCu Coating	
E.N. Eremin, V.M. Yurov and S.A. Guchenko	479
About Determing the Microhardness of Composite Coatings	
S.Y. Zhachkin, A.I. Zavrazhnov, N.A. Penkov, G.V. Kudryavtsev and P.V. Tsisarenko	486
Influence of Mechanical Activation and Mechanical Alloying on the Structure, Phase State of the Fe-Ni-Co-Al-Nb Powder Composition and on High-Entropy Coatings Based on it	
Z. Blednova, E.Y.O. Balaev and A.P. Yurkova	494
Features of Obtaining Multicomponent Magnetron Targets for the Formation of Non-Porous Transformation-Hardenable Coatings of a Given Composition	
R. Plomodyalo, Z. Blednova and D. Dmitrenko	503
Changing the Sizes of Details Made of Aluminum Alloys during Microarc Oxidation Process	
O. Tchufistov, E.A. Tchufistov and A.N. Zolkin	509
Investigation of the Properties of Heat-Protective Coatings to Improve the Performance of Products	
V. Smolentsev, N. Nenahov and N. Potashnikova	516
Wear Resistance of Experimental Hard Alloys Grades with Co-Mo-Ti Binders upon Conditions of Friction without Lubricant on Stainless Steel	
E.V. Fominov, M.S. Egorov, D.V. Moiseev, E. Dieudonne and C.G. Shuchev	522
Dependence of Surface Profile on Diamond Impregnation Characteristics	
N.V. Khripunov	528
Influence of the Initial Grain Size on the Structural-Phase State of the VT20 Titanium Alloy Surface after Implantation	
V.V. Ovchinnikov, I.A. Kurbatova, E.V. Luk'yanenko, N. Uchevatkina and S.V. Yakutina	535
Influence of the Structural State of Titanium Alloy on the Depth of Penetration of Ions during Implantation	
V.V. Ovchinnikov, S.V. Yakutina, I.A. Kurbatova, E.V. Luk'yanenko and N. Uchevatkina	541
Investigation of Residual Stresses during Processing of GTE Blades with Microbeads	
N.V. Nosov, Y.I. Kurguzov and D.A. Lyushnya	547
Numerical Simulation of the Laser Infusion Process of a Ni-Cr-B-Si Cover Strengthened with Zirconium Oxide Particles	
V. Alisin, M.N. Roshchin and J. Gladyszewski	552
Modification of the Surface of a Reconditioned Cutting Tool via Laser Ablation	
E. Yagyaev and S. Akimov	558
Modeling of the Contact Interaction of the Tool Indenter with the Part Surface when Processing by Surface Plastic Deformation Methods	
V.P. Fyodorov, M.N. Nagorkin, M.L. Kheifetz and E.A. Polsky	564
Theory of Formation of Edge's Surface Roughness Finished by Radial Polymer-Abrasive Brushes	
D. Podashev	571
Solving the Inverse Problem of Recovering the 3D Surface of a Detail According to its 2D Projections in the Modelling of Electroplating Processes	
I.A. Solovjeva, D.S. Solovjev and Y.V. Litovka	581
Properties of Vibro-Abrasive Treatment by Combination the Kinds and Granulometric Characteristics of the Medium	
Y. Kolganova, A. Azarova, B. Soldatov, N. Koval and G. Sanamyan	589
Grinding of High-Strength Materials	
T.N. Ivanova, W. Biały, J. Sitko, K. Midor and A. Muyzemnek	595

Evaluation of the Possibilities of Processing High-Alloy Corrosion-Resistant Steels during Grinding Operations	
A.M. Romanenko, D.B. Shatko, A.A. Nepogozhev and P.A. Strelnikov	603
Study of the Silicon Carbide Wear Area after Micro-Scratching of Titanium, Zirconium, Niobium and Molybdenum at a Speed of 35 m/s	
V.A. Nosenko, A.V. Fetisov, S.V. Nosenko, V.G. Karpov and V.E. Puzyrkova	614
Membrane Surface Morphology before and after the Reversible Hydrogen Doping of Diffusion Filters	
O.V. Akimova, I.S. Tereshina, T. Kaminskaya and I.A. Karateev	626

Chapter 5: Modeling and Numerical Evaluation of the Mechanical Properties of Materials

The Influence of Elastic Nonlinearity on Wave Processes in Media with Dislocations	
V.I. Erofeev, A.O. Malkhanov and A.V. Shekoyan	635
Influence of the Form Factor on the Results of the Fracture Process Modeling under Uniaxial Tension	
A.O. Taube, R.E. Novikov and E.I. Storozheva	641
Experimental and Analytical Determination of the Coefficient of Dynamic Loading in the Contact Interaction of Bodies	
D.N. Borodin, D.N. Misirov, S.V. Semergey, Y.P. Borzilov and V.N. Yeroenko	649
Neural Network Modeling of the Fatigue Strength of Metal Materials at Low Temperatures	
Y.G. Kabaldin, A.A. Khlybov, M.S. Anosov, D.A. Ryabov and A.V. Kiselev	655

Chapter 6: Building Materials

Structural Changes in Concrete under the Influence of Reactor Spectrum Neutrons	
M.A. Frolova, S.D. Strekalov, S.S. Bezotosny and P.A. Ponomarenko	663
The Damping Effect in the Propagation of the Cracks in Fine-Grained Carbonate Concrete	
V.V. Belov, P.V. Kuliaev and T.R. Barkaya	669
Estimation of the Probability of Cracking of Facade Coatings	
V. Loganina, R. Fediuk, D. Taranov and Y.H.M. Amran	675
Development of Compositions of New Enamel Coatings with Various Operational and Decorative Properties to Protect Steel Architectural and Construction Panels	
A.V. Ryabova, A.Y. Fanda, E.A. Yatsenko and M.G. Lee	684
Development of Polystyrene Foam Plates and Sprayed Concrete for Three-Layer Products and Structures	
Z. Okhunov, F. Aminov, O. Rasulov, A. Aminov and S. Mishra	693
Regulation of Rheological Properties of Three-Phase Dispersed Systems Used for the Production of Building Materials	
V.V. Belov and P.V. Kuliaev	699
Reducing the Emission Activity of Vanadium from Building Materials	
K.G. Pugin	705

Chapter 7: Technologies of Metallurgical and Metalworking Waste Recycling

Optimization of Compositions and Hardening Conditions of Vibropress Concretes Based on Steel-Making Slag	
I. Romanenko and A. Fadin	715
The Structure and Properties of Asphalt Concrete on the Basis of Waste Foundry Sand	
K.G. Pugin	721
Application of Fuel Ash as a Microfiller in Cement Dispersion Systems	
V. Petropavlovskaya, T.B. Novichenkova, K. Petropavlovskii, O.V. Aleksandrova and H.B. Fischer	729

Steelmaking Slag - A Complex Material for the Production of Small-Size Materials Using Hyper-Press Technology I. Romanenko and A. Fadin	737
Obtaining Calcium Sulfoaluminate Using Aluminate Waste I.Y. Burlov, D.A. Zorin and Y.R. Krivoborodov	743
Novel Materials for Myco-Decontamination of Cyanide-Containing Wastewaters through Microbial Biotechnology I.N. Pavlov and Y.A. Litovka	751
Improving the Efficiency of Metal Production Waste Processing in Electromagnetic Field V.A. Lebedev, Y.M. Vernigorov, A.A. Shirin, L.V. Chunakhova and E.P. Melnikova	759
Investigation of the Fluxing Additives Effect on the Foaming of Different Silicate Raw Materials B.M. Goltsman, E.A. Yatsenko, L.A. Yatsenko, N.S. Goltsman and D.M. Kuzmenkov	767