

8th International Conference on Laser Assisted Net Shape Engineering (LANE 2014)

Physics Procedia Volume 56

**Fürth, Germany
8-11 September 2014**

Part 1 of 2

Editors:

**M. Schmidt
F. Vollertsen
M. Merklein**

ISBN: 978-1-63439-356-0

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© by Elsevier B.V.
All rights reserved.

Printed by Curran Associates, Inc. (2014)

For permission requests, please contact Elsevier B.V.
at the address below.

Elsevier B.V.
Radarweg 29
Amsterdam 1043 NX
The Netherlands

Phone: +31 20 485 3911
Fax: +31 20 485 2457

<http://www.elsevierpublishingsolutions.com/contact.asp>

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

**VOLUME 1**

Preface

M. Schmidt, F. Vollertsen, M. Merklein.	1
--	---

Next Generation Beam Deflection

Micro Mirrors for High-speed Laser Deflection and Patterning H. Schenk, J. Grahmann, T. Sandner, M. Wagner, U. Dauderstädt, J.-U. Schmidt.	7
Comparison of High Rate Laser Ablation and Resulting Structures Using Continuous and Pulsed Single Mode Fiber Lasers T. Knebel, A. Streek, H. Exner.	19
Electro-optic and Acousto-optic Laser Beam Scanners G.R.B.E. Römer, P. Bechtold.	29
Electro-optic KTN Devices S. Yagi, K. Fujiura.	40

Additive Manufacturing - SLM Metals

Experimental Approbation of Selective Laser Melting of Powders by the Use of Non-gaussian Power Density Distributions A. Okunkova, M. Volosova, P. Peretyagin, Y. Vladimirov, I. Zhirnov, A.V. Gusarov.	48
Microstructure-controllable Laser Additive Manufacturing Process for Metal Products W.-C. Huang, C.-S. Chuang, C.-C. Lin, C.-H. Wu, D.-Y. Lin, S.-H. Liu, W.-P. Tseng, J.-B. Horng.	58
Layerwise Monitoring of the Selective Laser Melting Process by Thermography H. Krauss, T. Zeugner, M.F. Zaeh.	64
Characterization of Effect of Support Structures in Laser Additive Manufacturing of Stainless Steel J.-P. Järvinen, V. Matilainen, X. Li, H. Piili, A. Salminen, I. Mäkelä, O. Nyrhilä.	72
Low Coherence Interferometry in Selective Laser Melting A. Neef, V. Seyda, D. Herzog, C. Emmelmann, M. Schönleber, M. Kogel-Hollacher.	82
Developing LBM Process Parameters for Ti-6Al-4V Thin Wall Structures and Determining the Corresponding Mechanical Characteristics B. Ahuja, A. Schaub, M. Karg, M. Lechner, M. Merklein, M. Schmidt.	90
Effect of IN718 Recycled Powder Reuse on Properties of Parts Manufactured by Means of Selective Laser Melting L.C. Ardila, F. Garciandia, J.B. González-Díaz, P. Álvarez, A. Echeverría, M.M. Petite, R. Deffley, J. Ochoa.	99
Selective Laser Melting Additive Manufacturing of TiC/AlSi10Mg Bulk-form Nanocomposites with Tailored Microstructures and Properties D. Gu, H. Wang, F. Chang, D. Dai, P. Yuan, Y.-C. Hagedorn, W. Meiners.	108
Direct Selective Laser Sintering/Melting of High Density Alumina Powder Layers at Elevated Temperatures J. Deckers, S. Meyers, J.P. Kruth, J. Vleugels.	117
Production of Al/Cu-Particles and their Potential for Processing by Laser Beam Melting (LBM) M. Sachs, O. Hentschel, J. Schmidt, M. Karg, M. Schmidt, K.-E. Wirth.	125
Fabrication and Characterization of High Strength Al-Cu Alloys Processed Using Laser Beam Melting in Metal Powder Bed B. Ahuja, M. Karg, K.Yu. Nagulin, M. Schmidt.	135

Additive Manufacturing - SLM Polymers

Performance Limitations in Polymer Laser Sintering D.L. Bourell, T.J. Watt, D.K. Leigh, B. Fulcher.	147
Powder Layer Preparation Using Vibration-controlled Capillary Steel Nozzles for Additive Manufacturing T. Stichel, T. Laumer, T. Baumüller, P. Amend, S. Roth.	157
Analysis of Temperature Gradients during Simultaneous Laser Beam Melting of Polymers T. Laumer, T. Stichel, P. Amend, S. Roth, M. Schmidt.	167
Influence of Energy Input on Degradation Behavior of Plastic Components Manufactured by Selective Laser Melting D. Drummer, K. Wudy, M. Drexler.	176
Impact of Heating Rate During Exposure of Laser Molten Parts on the Processing Window of PA12 Powder D. Drummer, M. Drexler, K. Wudy.	184

Additive Manufacturing - LDMD and Cladding

Laser-optic Measurements of Velocity of Particles in the Powder Stream at Coaxial Laser Cladding D.V. Sergachev, A.A. Mikhail'chenko, O.B. Kovalev, V.I. Kuz'min, G.N. Grachev, P.A. Pinaev.	193
Influence of the Laser and its Scan Width in the LDNA Surfacing Process A. Barroi, J. Amelia, J. Hermsdorf, S. Kaierle, V. Wesling.	204
Design of a Model-based Controller with Temperature Feedback for Laser Cladding W. Devesse, D. De Baere, P. Guillaume.	211

The Prediction of Coating Geometry from Main Processing Parameters in Laser Cladding O. Nenadl, V. Ocelík, A. Palavra, J.Th.M. De Hosson	220
Correlations of Melt Pool Geometry and Process Parameters During Laser Metal Deposition by Coaxial Process Monitoring S. Ocylok, E. Alexeev, S. Mann, A. Weisheit, K. Wissenbach, I. Kelbassa	228
Improvement of the Laser Direct Metal Deposition Process in 5-axis Configuration D. Boisselier, S. Sankaré, T. Engel	239
On the Influence of Laser Cladding and Post-processing Strategies on Residual Stresses in Steel Specimens H. Köhler, R. Rajput, P. Khazan, J.R. Kornmeier	250
Study of 3D Laser Cladding for Ni85Al15 Superalloy D. Kotoban, S. Grigoriev, I. Shishkovsky	262
Laser Cladding of Ni-WC Layers with Graded WC Content J.M. Amado, J. Montero, M.J. Tobar, A. Yáñez	269
Laser Cladding of MCrAlY Coatings on Stainless Steel M.J. Tobar, J.M. Amado, A. Yáñez, J.C. Pereira, V. Amigó	276
Laser Cladding of TiAl Intermetallic Alloy on Ti6Al4V. Process Optimization and Properties B. Cárcel, A. Serrano, J. Zambrano, V. Amigó, A.C. Cárcel	284
Corrosion Resistance of Laser Clads of Inconel 625 and Metco 41C S. Němeček, L. Fidler, P. Fišerová	294
Challenges for Single-crystal (SX) Crack Cladding B. Rottwinkel, L. Schweitzer, C. Noelke, S. Kaierle, V. Wesling	301
Bioceramic 3D Implants Produced by Laser Assisted Additive Manufacturing F. Lusquiños, J. del Val, F. Arias-González, R. Comesaña, F. Quintero, A. Riveiro, M. Boutinguiza, J.R. Jones, R.G. Hill, J. Pou	309
Additive Manufacturing - Alternative Processes	
Characterization of Process Efficiency Improvement in Laser Additive Manufacturing V. Matilainen, H. Piili, A. Salminen, T. Syvänen, O. Nyrhilä	317
Load-dependent Optimization of Honeycombs for Sandwich Components –New Possibilities by Using Additive Layer Manufacturing F. Riss, J. Schilp, G. Reinhart	327
Manufacturing of Conductive Circuits for Embedding Stereolithography by Means of Conductive Adhesive and Laser Sintering B. Niese, T. Stichel, P. Amend, U. Urmonait, S. Roth, M. Schmidt	336
On the Possibility of Selective Laser Melting of Quartz Glass R.S. Khmyrov, S.N. Grigoriev, A.A. Okunkova, A.V. Gusarov	345
Experimental Investigation on Selective Laser Melting of Glass M. Fateri, A. Gebhardt, S. Thuemmler, L. Thurn	357
Laser Spinning: A New Technique for Nanofiber Production J. Penide, F. Quintero, J. del Val, R. Comesaña, F. Lusquiños, A. Riveiro, J. Pou	365
Additive Manufacturing - Simulation and Modelling	
Effects of Defects in Laser Additive Manufactured Ti-6Al-4V on Fatigue Properties E. Wycisk, A. Solbach, S. Siddique, D. Herzog, F. Walther, C. Emmelmann	371
Numerical Model based Reliability Estimation of Selective Laser Melting Process S. Mohanty, J.H. Hattel	379
Computer Aided Optimisation of the Thermal Management During Laser Beam Melting Process A. Ilin, R. Logvinov, A. Kulikov, A. Prihodovsky, H. Xu, V. Ploshikhin, B. Günther, F. Bechmann	390
Model of Heat and Mass Transfer in Random Packing Layer of Powder Particles in Selective Laser Melting I. Kovaleva, O. Kovalev, I. Smurov	400
Mathematical Modeling of Crystal Growth and Microstructure Formation in Multi-layer and Multi-track Laser Powder Deposition of Single-crystal Superalloy Z. Liu, H. Qi	411
Non-disturbing Boundary Conditions for Modeling of Laser Material Processing I.O. Kovaleva, S.N. Grigoriev, A.V. Gusarov	421
Continuous Coaxial Nozzle Design for LMD based on Numerical Simulation J.I. Arrizubieta, I. Tabernero, J.E. Ruiz, A. Lamikiz, S. Martinez, E. Ukar	429
Modeling and Numerical Study of Light-propulsion Phenomena of Particles Acceleration in Coaxial Laser Powder Cladding I. Kovaleva, O. Kovalev, A.V. Zaitsev, D.V. Sergachev	439
Welding Metals - Macro	
Methods for Improving Laser Beam Welding Efficiency M. Sokolov, A. Salminen	450
Laser Beam Oscillation Strategies for Fillet Welds in Lap Joints A. Müller, S.-F. Goecke, P. Sievi, F. Albert, M. Rethmeier	458
Beam Shaping to Control of Weldpool Size in Width and Depth K.S. Hansen, M. Kristiansen, F.O. Olsen	467

Impact of Process Parameters on the Laser-induced Nanoparticle Formation During Keyhole Welding under Remote Conditions T. Scholz, K. Dickmann, A. Ostendorf	477
Testing of New Materials and Computer Aided Optimization of Process Parameters and Clamping Device During Predevelopment of Laser Welding Processes P. Weidinger, K. Günther, M. Fitzel, R. Logvinov, A. Ilin, V. Ploshikhin, F. Hugger, V. Mann, S. Roth, M. Schmidt	487
Effects of Sealing Run Welding with Defocused Laser Beam on the Quality of T-joint Fillet Weld A. Unt, I. Poutiainen, A. Salminen	497
Effect of Nanopowder Modifiers on Properties of Metal Laser-welded Joints A.M. Orishich, A.G. Malikov, A.N. Cherepanov	507
Experimental and Numerical Investigation of an Electromagnetic Weld Pool Control for Laser Beam Welding M. Bachmann, V. Avilov, A. Gumenyuk, M. Rethmeier	515
Laser Beam Welding of Ultra-high Strength Chromium Steel with Martensitic Microstructure M. Dahmen, V. Janzen, S. Lindner, R. Wagener	525
Remote Laser Welding of Zinc Coated Steel Sheets in an Edge Lap Configuration with Zero Gap C. Roos, M. Schmidt	535
Gap Bridging Ability in Laser Beam Welding of Thin Aluminum Sheets V. Schultz, T. Seefeld, F. Vollertsen	545
Helium-tight Laser Beam Welding of Aluminum with Brilliant Laser Beam Radiation P. Heinen, H. Wu, A. Olowinsky, A. Gillner	554
Effect of Peculiarities of Heat Transfer, Diffusion and Phase Transformation on Joint Formation During Welding of Dissimilar Materials by High Power Fiber Laser G. Turichin, O. Klimova, E. Valdaytseva	566
Laser Beam Welding of Brass F. Hugger, K. Hofmann, S. Stein, M. Schmidt	576
Laser Beam Welding of Thick Titanium Sheets in the Field of Marine Technology A. Schneider, A. Gumenyuk, M. Lammers, A. Malletschek, M. Rethmeier	582
Laser Welding of Copper Using Multi Mode Fiber Lasers at Near Infrared Wavelength S. Liebl, R. Wiedenmann, A. Ganser, P. Schmitz, M.F. Zaeh	591
Reliable Copper and Aluminum Connections for High Power Applications in Electromobility K. Hofmann, M. Holzer, F. Hugger, S. Roth, M. Schmidt	601
Investigations on Laser Beam Welding Dissimilar Material Combinations of Austenitic High Manganese (FeMn) and Ferrite Steels V. Behm, M. Höfemann, A. Hatscher, A. Springer, S. Kaierle, D. Hein, M. Otto, L. Overmeyer	610
Gap Bridging Ability in Laser GMA Hybrid Welding of Thin 22MnB5 Sheets F. Möller, H. Kügler, S. Kötschau, A. Geier, S.-F. Goecke	620
Thick-section Laser and Hybrid Welding of Austenitic Stainless Steels V. Kujanpää	630
GMA-laser Hybrid Welding of High-strength Fine-grain Structural Steel with an Inductive Preheating R. Lahdo, O. Seffer, A. Springer, S. Kaierle, L. Overmeyer	637
Influence of Welding Current and Focal Position on the Resonant Absorption of Laser Radiation in a TIG Welding Arc B. Emde, M. Huse, J. Hermsdorf, S. Kaierle, V. Wesling, L. Overmeyer	646
Laser Submerged Arc Welding (LUPuS) with Solid State Lasers U. Reisgen, S. Olschok, S. Jakobs	653
Undercuts in Laser Arc Hybrid Welding J. Frostevarg, A.F.H. Kaplan	663
Laser Glass Frit Sealing for Encapsulation of Vacuum Insulation Glasses H. Kind, E. Gehlen, M. Aden, A. Olowinsky, A. Gillner	673
Laser Brazing and Welding	
Reduction of Focal Shift Effects in Industrial Laser Beam Welding by Means of Innovative Protection Glass Concept M. Hemmerich, C. Thiel, F. Lupp, H. Hanebuth, R. Weber, T. Graf	681
Laser Brazing with Beam Scanning: Experimental and Simulative Analysis M. Heitmanek, M. Dobler, M. Graudenz, W. Perret, G. Göbel, M. Schmidt, E. Beyer	689
Two-beam Laser Brazing of Thin Sheet Steel for Automotive Industry Using Cu-base Filler Material C. Mittelstädt, T. Seefeld, D. Reitemeyer, F. Vollertsen	699
Influences of Nozzle Material on Laser Droplet Brazing Joints with Cu89Sn11 Preforms S. Stein, J. Heberle, F.J. Gürtler, K. Cvecek, S. Roth, M. Schmidt	709
Laser Droplet Generation from a Metal Foil A. Jeromen, A. Kuznetsov, E. Govekar	720
The Role of Zinc Layer During Wetting of Aluminium on Zinc-coated Steel in Laser Brazing and Welding M. Gatzten, T. Radel, C. Thomy, F. Vollertsen	730

VOLUME 2

Welding Metals - Micro

Process-limiting Factors and Characteristics of Laser-based Micro Welding A. Patschger, J. Bliedtner, J.P. Bergmann	740
Tailored Beam Shaping for Laser Spot Joining of Highly Conductive Thin Foils K. Funck, R. Nett, A. Ostendorf	750
Laser Spot Welding of Copper-Aluminum Joints Using a Pulsed Dual Wavelength Laser at 532 and 1064 nm P. Stritt, C. Hagenlocher, C. Kizler, R. Weber, C. Rüttimann, T. Graf	759
Examinations on Laser Remote Welding of Ultra-thin Metal Foils Under Vacuum Conditions M. Petrich, M. Stambke, J.P. Bergmann	768
Laser Micro Welding for Ribbon Bonding B. Mehlmann, E. Gehlen, A. Olowinsky, A. Gillner	776

Joining Metals with Polymers

Macroscopic Surface Structures for Polymer-metal Hybrid Joints Manufactured by Laser based Thermal Joining K. Schrickler, M. Stambke, J.P. Bergmann, K. Bräutigam, P. Henckell	782
Influence of Structuring by Laser and Plasma Torch on the Adhesion of Metallic Films on Thermoplastic Substrates W. Knapp, D. Djomani, J.F. Coulon, R. Grunche	791
Laser-generated Macroscopic and Microscopic Surface Structures for the Joining of Aluminum and Thermoplastics using Friction Press Joining A.N. Fuchs, F.X. Wirth, P. Rinck, M.F. Zaeh	801
Investigating Thermal Interactions in the Case of Laser Assisted Joining of PMMA Plastic and Steel A. Bauernhuber, T. Markovits	811
Comparing Adhesive Bonding and LAMP Joining Technology in Case of Hybrid Material Combination T. Markovits, A. Bauernhuber	818
Experimental Investigations of Thermal Joining of Polyamide Aluminum Hybrids Using a Combination of Mono- and Polychromatic Radiation P. Amend, C. Mohr, S. Roth	824
A Combined Experimental and Numerical Approach to the Laser Joining of Hybrid Polymer–Metal Parts E. Rodríguez-Vidal, J. Lambarri, C. Soriano, C. Sanz, G. Verhaeghe	835
Laser Assisted Joining of Hybrid Polyamide-Aluminum Structures C. Lamberti, T. Solchenbach, P. Plapper, W. Possart	845

Laser Cutting

Energy and Resource Efficiency of Laser Cutting Processes K. Kellens, G.C. Rodrigues, W. Dewulf, J.R. Dufflou	854
Combustion Effects in Laser-oxygen Cutting: Basic Assumptions, Numerical Simulation and High Speed Visualization A.V. Zaitsev, G.V. Ermolaev	865
Experimental Comparison of Laser Cutting of Steel with Fiber and CO ₂ Lasers on the Basis of Minimal Roughness A.M. Orishich, A.G. Malikov, V.B. Shulyatyev, A.A. Golyshev	875
Measurement of Cut Front Properties in Laser Cutting U. Thombansen, T. Hermanns, T. Molitor, M. Pereira, W. Schulz	885
Experimental Analysis for Improvements of Process Efficiency and Cut Edge Quality of Fusion Cutting with 1 μm Laser Radiation C. Goppold, K. Zenger, P. Herwig, A. Wetzig, A. Mahrle, E. Beyer	892
Direct Diode Lasers for Industrial Laser Cutting: A Performance Comparison with Conventional Fiber and CO ₂ Technologies G.C. Rodrigues, H. Vanhove, J.R. Dufflou	901
The Application of Specific Point Energy Analysis to Laser Cutting with 1 μm Laser Radiation M. Hashemzadeh, W. Suder, S. Williams, J. Powell, A.F.H. Kaplan, K.T. Voisey	909

Short Pulse Processing

High Precision Laser Processing of Steel Surfaces with Sub-ns-lasers S. Brüning, G. Jenke, K. Du, A. Gillner	919
Laser Fabrication of Silica Gratings by Ablation and Modification of Silicone Films A. Dittrich, T. Fricke-Begemann, J. Ihlemann	927
Nanosecond Pulsed Laser Processing of Ion Implanted Single Crystal Silicon Carbide Thin Layers T. Özel, T. Thepsonthi, V.P. Amarasinghe, G.K. Celler	933
Pattern Transfer of Sub-micrometre-scaled Structures into Solid Copper by Laser Embossing M. Ehrhardt, P. Lorenz, A. Lotnyk, H. Romanus, E. Thelander, K. Zimmer	944
Ablation Study of WC and PCD Composites Using 10 Picosecond and 1 Nanosecond Pulse Durations at Green and Infrared Wavelengths G. Eberle, K. Wegener	951
Influence of the Pulse Duration onto the Material Removal Rate and Machining Quality for Different Types of Steel B. Lauer, B. Jäggi, B. Neuenschwander	963

Ultrashort Pulse Processing

Characterization of Plasma in Microwelding of Glass Using Ultrashort Laser Pulse at High Pulse Repetition Rates I. Miyamoto, Y. Okamoto, R. Tanabe, Y. Ito	973
---	-----

Laser Processing of Thin Glass Printed Circuit Boards with a Picosecond Laser at 515 nm Wavelength K. Plat, P.V. Witzendorff, O. Suttmann, L. Overmeyer	983
The Influence of Laser Induced Consolidation on the Ablation Threshold of Nanoparticulate ITO-layers F. Mikschl, M. Baum, J. Heberle, I. Alexeev, M. Schmidt	991
The Combination of Direct and Confined Laser Ablation Mechanisms for the Selective Structuring of Thin Silicon Nitride Layers S. Rapp, G. Heinrich, M. Domke, H.P. Huber	998
Understanding Thin Film Laser Ablation: The Role of the Effective Penetration Depth and the Film Thickness M. Domke, L. Nobile, S. Rapp, S. Eiselen, J. Sotrop, H.P. Huber, M. Schmidt	1007
Laser Structuring of Thin Layers for Flexible Electronics by a Shock Wave-induced Delamination Process P. Lorenz, M. Ehrhardt, K. Zimmer	1015
In-process Evaluation of Electrical Properties of CIGS Solar Cells Scribed with Laser Pulses of Different Pulse Lengths K. Zimmer, X. Wang, P. Lorenz, L. Bayer, M. Ehrhardt, C. Scheit, A. Braun	1024
Observation of a Spot Diameter Dependency in Confined Laser Ablation of Zinc Oxide on Copper-Indium-Diselenide R. Moser, D. Seiler, H.P. Huber, G. Marowsky	1034
Ultra-short Pulse Laser Structuring of Molding Tools D. Conrad, L. Richter	1041
Surface Structuring with Ultra-short Laser Pulses: Basics, Limitations and Needs for High Throughput B. Neuenschwander, B. Jaeggi, M. Schmid, G. Hennig	1047
Fabrication of Complex Micro/Nanopatterns on Semiconductors by the Multi-beam Interference of Femtosecond Laser X. Jia, L. Dong	1059
High-precision Helical Cutting Using Ultra-short Laser Pulses C. He, F. Zibner, C. Fornaroli, J. Ryll, J. Holtkamp, A. Gillner	1066
Surface Treatment	
NIR-CW-Laser Annealing of Room Temperature Sputtered ZnO:Al V. Schütz, V. Sittinger, S. Götzendörfer, C.C. Kalmbach, R. Fu, P. von Witzendorff, C. Britze, O. Suttmann, L. Overmeyer	1073
Development of a Flexible Laser Hardening & Machining Center and Proof of Concept on C-45 Steel J. Bouquet, D. Van Camp, H. Vanhove, S. Clijsters, M. Amirahmad, B. Lauwers	1083
Particle Property Impact on its Distribution During Laser Deep Alloying Processes J. Volpp, T. Dietz, F. Vollertsen	1094
Study on Fiber-optic Hydrogen Sulfide Gas Sensor H. Zhou, J.-Q. Wen, X.-Z. Zhang, W. Wang, D.-Q. Feng, Q. Wang, F. Jia	1102
Laser Roughing of PCD C. Brecher, M. Emonts, J.-P. Hermani, T. Storms	1107
Laser Nanostructuring of the PbX Thin Films for Creation of the Semiconductor Devices with Controlled Properties S.M. Arakelian, D.N. Bukharov, V.I. Emel'yanov, S.P. Zimin, S.V. Kutrovskaya, A.O. Kucherik, A.A. Makarov, A.V. Osipov	1115
Effect of Q-switched Laser Surface Texturing of Titanium on Osteoblast Cell Response K.T. Voisey, C.A. Scotchford, L. Martin, H.S. Gill	1126
Exchange Bias Realignment Using a Laser-based Direct-write Technique I. Berthold, U. Löschner, J. Schille, R. Ebert, H. Exner	1136
Fiber Reinforced Polymers	
Comparative Study of Achievable Quality Cutting Carbon Fibre Reinforced Thermoplastics Using Continuous Wave and Pulsed Laser Sources S. Bluemel, P. Jaeschke, O. Suttmann, L. Overmeyer	1143
Laser Cutting of Carbon Fiber Reinforced Plastics – Investigation of Hazardous Process Emissions J. Walter, M. Hustedt, R. Staehr, S. Kaieler, P. Jaeschke, O. Suttmann, L. Overmeyer	1153
Numerical Simulation of Laser Beam Cutting of Carbon Fiber Reinforced Plastics T. Ohkubo, M. Tsukamoto, Y. Sato	1165
Laser Surface Pre-treatment of Aluminium for Hybrid Joints with Glass Fibre Reinforced Thermoplastics A. Heckert, M.F. Zaeh	1171
Laser Transmission Welding of CFRTP Using Filler Material S. Berger, M. Schmidt	1182
Advanced Laser Transmission Welding Strategies for Fibre Reinforced Thermoplastics V. Wippo, P. Jaeschke, M. Brueggmann, O. Suttmann, L. Overmeyer	1191
Simulation of Light Propagation within Glass Fiber Filled Thermoplastics for Laser Transmission Welding M. Hohmann, M. Devrient, F. Klämpfl, S. Roth, M. Schmidt	1198
Calibrated Heat Flow Model for Determining the Heat Conduction Losses in Laser Cutting of CFRP P. Mucha, R. Weber, N. Speker, P. Berger, B. Sommer, T. Graf	1208
Sensing and Control	
Monitoring and Adaptive Control of Laser Processes T. Purtonen, A. Kalliosaari, A. Salminen	1218

Monitoring of Laser and Hybrid Welding of Steels and Al-alloys G. Turichin, E. Zemlyakov, K. Babkin, A. Kuznetsov	1232
Optimization Strategies for Laser Welding High Alloy Steel Sheets F. Nagel, F. Simon, B. Kümmel, J.P. Bergmann, J. Hildebrand	1242
Online Condition Measurement of High Power Solid State Laser Cutting Optics using Ultrasound Signals B. Neumeier, D. Schmitt-Landsiedel	1252
Plasma Bursts in Deep Penetration Laser Welding L. Mrňa, M. Šarbort	1261
Experimental and Numerical Analysis of Gas Dynamics in the Keyhole During Laser Metal Welding F. Tenner, C. Brock, F.-J. Gürtler, F. Klämpfl, M. Schmidt	1268
Neutron Strain Scanning of Fibre and Diode Laser Welds in Stainless Steel and Ti6Al4V K.T. Voisey, J. Folkes, J. Srithorn, D.J. Hughes	1277
Illumination for Process Observation in Laser Material Processing U. Thombansen, M. Ungers	1286
Laser Measurements based for Volumetric Accuracy Improvement of Multi-axis Systems S. Vladimir, B. Konstantin	1297
3D Polymer Weld Seam Characterization based on Optical Coherence Tomography for Laser Transmission Welding Applications R. Schmitt, G. Mallmann, M. Devrient, M. Schmidt	1305
Simulation and Modeling	
Multiphysical Simulation of ns-Laser Ablation of Multi-material LED-Structures A. Otto, H. Koch, R.G. Vázquez, Z. Lin, B. Hainsey	1315
Finite-difference Time-domain Modeling of Laser-induced Periodic Surface Structures G.R.B.E. Römer, J.Z.P. Skolski, J.V. Oboňa, A.J. Huis in 't Veld	1325
Multi-physical Simulation of Laser Welding R.G. Vázquez, H.M. Koch, A. Otto	1334
Residual Stress Formation Relating to Peak Temperature- and Austenite Grain Size-based Phase Transformation of S355 Steel F. Klaproth, F. Vollertsen	1343
Nonlinearity and Phase Noise Mitigation Using Feed-forward Carrier Phase Estimation and Digital Backward Propagation in Coherent QAM Transmission L. Pakala, B. Schmauss	1353
Energy of Nonlinear Optical Solitons for Optical Sensors A.C.A. de Faria Jr	1358
Laser Safety	
Temporary Blinding Limits Versus Maximum Permissible Exposure—A Paradigm Change in Risk Assessment for Visible Optical Radiation H.-D. Reidenbach	1366
Influence of Laser Beam Diameter on the Resistance of Laser Protection Filters to Laser Radiation U. Urmoneit, A. Hotz, T. Fröhlich, H.-J. Krauß	1377
Laser Intensity as a Basis for the Design of Passive Laser Safety Barriers—A Dangerous Approach F.P. Lugauer, S. Braunreuther, R. Wiedenmann, M.F. Zaeh	1384
Closing Plenary - Laser Assisted Processes	
Optimization of Beam Mode for High Efficiency Laser Thermal Forming within Metallurgical Constraints S.P. Edwardson, J. Griffiths, G. Sheikholeslami, G. Dearden	1392
Influence of Pre-straining and Heat Treatment on the Yield Surface of Precipitation Hardenable Aluminum Alloys M. Lechner, M. Johannes, A. Kuppert, M. Merklein	1400
Influence of a Short Term Heat Treatment by Conduction and Induction on the Mechanical Properties of AA6014 Alloys K. Alexander, W. Daniel, M. Marion	1410
Laser-assisted Property Gradients in Multi-layered Aluminum W. Böhm, M. Merklein	1419
Double Sided Irradiation for Laser-assisted Shearing of Ultra High Strength Steels with Process Integrated Hardening C. Brecher, M. Emonts, M. Eckert, M. Weinbach	1427