

Advances in Abrasive Technology XVII

Selected, peer reviewed papers from the 17th International Symposium on Advances in Abrasive Technology (ISAAT 2014), September 22-25, 2014, Hawaii, USA

von

Akinori Yui, Jiwang Yan, Hideki Aoyama

1. Auflage

Trans Tech Publications 2014

Verlag C.H. Beck im Internet:
www.beck.de

ISBN 978 3 03835 221 1

Table of Contents

Preface, Committees and Sponsors

Chapter 1: Abrasive Machining

On the Profile and Microstructure Variations of Grinding-Induced Hardening Layer in A Cylindrical Workpiece M. Liu, T. Nguyen, L.C. Zhang, Q. Wu and D.L. Sun	3
Study on Grinding Force Distribution on Cup Type Electroplated Diamond Wheel in Face Grinding of Cemented Carbide T. Fujiwara, S. Tsukamoto, K. Ohashi and T. Onishi	9
Investigations on Belt Grinding of GH4169 Nickel-Based Superalloy G.J. Xiao, Y. Huang, G.L. Chen, Z.W. Liu and X.M. Liu	15
Basic Study on High Efficiency Ultra-Precision Grinding of the Optical Glass Lens R. Sekiguchi, S. Yoshikawa, Y. Kakinuma, K. Tanaka and M. Fukuta	21
Studies on Grinding Conditions Affecting the Quality of Soft Magnetic Powder Cores T. Ueno, T. Tokuoka, T. Nishioka, K. Ohashi and S. Tsukamoto	27
Effect of Coolant Supplied through Grinding Wheel on Residual Stress of Grinding Surface N. Nakatsuka, Y. Hirai, A. Kusakabe, Y. Yao and H. Sasahara	33
Multi-Hole Drilling Method by Abrasive Blasting for CFRP and Composite Materials: Investigation of a Processing Model Based on Abrasive Erosion Phenomenon H. Fukagawa, T. Hirogaki, I. Yamada, A. Kato, K. Shimizu and K. Nishikawa	38
A Controllable Material Removal Strategy Considering Force-Geometry Model in Marine Propeller Five-Axis Belt Grinding Y.Q. Wang, B. Hou, Q. Ma, H.B. Liu and X.J. Sheng	44
Form Accuracy of Internal Grinding of Small and Deep Holes with Coolant Supplied from Inner Side of Grinding Wheel K. Matsubara, J. Tsuchimura, S. Kawazoe and H. Sasahara	50
An Experimental Study on Grinding Fir-Tree Root Forms Using Vitrified CBN Wheels Z.D. Shi, A. Elfizy and H. Attia	55
Deformation and Removal Characteristics of Multilayered Thin Film Structures in Nanoscratching and Diamond Lapping C.W. Kang and H. Huang	61
Influence of Work Speed on Surface Quality with Rapid Rotation Mirror-Like Surface Grinding K. Yamaguchi, R. Yamazaki, C.H. Yu, M. Ota, K. Egashira, Y. Akita and S. Suzuki	66
Estimation of Grinding Cycle Time Taking into Account Specific Grinding Force T. Yamada, H.S. Lee and K. Miura	72
Study on the Shape Error in the Cylindrical Traverse Grinding of a Workpiece with High Aspect Ratio T. Onishi, T. Kodani, K. Ohashi, M. Sakakura and S. Tsukamoto	78
Research on Material Removal Mechanism of Single Grit Cutting Based on FEM Simulation L. Yan, F. Jiang and C.F. Fang	82
A Preliminary Study of Surface Integrity and Wheel Wear in the Grinding of Multilayered Thin Film Structures C.W. Kang, B.J. Hao and H. Huang	88
Experiment Research on ZrO₂ Engineering Ceramics with Abrasive Belt Grinding D. Zhang, Y. Huang, X. Yin, L.Q. Zhou, Y.H. Yang and L. Yong	92
Research on Grinding of Silicon Particles Reinforced Aluminum Matrix Composites with High Volume Fraction F.H. Zhang, K. Wang, P.Q. Fu and M.N. Wu	98
Investigation of Grinding Characteristics of Cemented Carbides YL10.2 and YF06 T. Xu, J.W. Yu, Z.J. Zhang, J.G. Tu, X.Z. Liu, Y. Wu and L.H. He	104

Optimization of Grinding Conditions in Non-Axisymmetric Aspherical Grinding N. Yoshihara, T. Nakagawa, N. Nishikawa and M. Mizuno	109
Study on the Grinding Machinability of 9Mn2V under Different Heat Treatment Processes G.Q. Guo, Y.J. Mu, C.Q. Yang, Z.Q. Li, Y. Tian and M. Chen	114
Study on Force Characteristics of Ultrasonic Vibration-Assisted Sawing Ceramics with Diamond Blade X. Xiang, J.Y. Shen, Z.W. Hu and X.P. Xu	120

Chapter 2: Surface Quality

Investigation of Glass Polishing Motion Based on Micro-Oscillating Pressing Force with a Compact Robot and Fine Diamond Stone W. Wu, Y.D. Liu, T. Hirogaki and E. Aoyama	129
Development of Non-Destructive Inspection System for Grinding Burn-in-Process Detection of Grinding Burn R. Ito, N. Mukaide, T. Azuma, S. Soma, S. Murakami and T. Kuriyagawa	135
Feature Extraction Based 3D Model Registration for Surface Finish Quality Evaluation N. Sharma, J. Zhu, T. Tanaka and Y. Saito	141
Dry Sliding Wear Behaviour of Full Pearlite Obtained by Cladding Low Carbon Steel to Hypoeutectoid Steel X.J. Gao, Z.Y. Jiang, D.B. Wei, B.Y. Kosasih, S.H. Jiao and D.F. Chen	147
Material Properties of a New PCD Made of Boron Doped Diamond Particles W. Chen, M. Iwai, S. Ninomiya and K. Suzuki	154
Dynamic Friction Polishing of Diamond Utilizing High Reactive Metallic Tools W. Chen, M. Iwai and K. Suzuki	160
Evaluation and ANN-Based Prediction on Functional Parameters of Surface Roughness in Precision Grinding of Cast Iron B. Zhao, S. Zhang and J.F. Li	166

Chapter 3: Brittle Material Machining

An Experimental Study on Single Point Diamond Turning of an Unpolished Silicon Wafer via Micro-Laser Assisted Machining H. Mohammadi, H.B. Poyraz, D. Ravindra and J.A. Patten	175
Effect of Cutting Fluid on Diamond Tool Life under Micro V-Groove Turning of Cobalt-Free Tungsten Carbide A. Yui, T. Kitajima, P. Krajnik, K. Harano, H. Sumiya and H. Ono	181
A Three-Dimensional Fractal Analysis Method for Ground Monocrystal Sapphire Surface Q.Y. Wang, Z.Q. Liang, X.B. Wang, W.X. Zhao, Y.B. Wu, L. Jiao and L.J. Xie	187
Microgrooving of Germanium Wafers Using Laser and Hybrid Laser-Waterjet Technologies H. Zhu, J. Wang, W.Y. Li and H.Z. Li	193
An SPH Simulation on Vibration Assisted Abrasive Erosion of Hard Brittle Material in Abrasive Waterjet Machining Z. Lv, C.Z. Huang, H.T. Zhu, J. Wang, P. Yao and Z.W. Liu	199
Machining Characteristics in Cylindrical Blasting of Micro Grooves and Performance of Herring-Bone Bearing T. Fukushima, K. Ohashi, M. Fujihara, T. Onishi and S. Tsukamoto	205
Study on the Model of Surface Crack Depth in Ceramics Grinding J.K. Su, B. Lin and L. Wang	212
Radial Directional Vibration-Assisted Ductile-Mode Grinding of Engineering Ceramic K. Imai	218
Blind Hole Machining of Quartz Fiber Reinforced Ceramic Matrix Composites by Helical Milling with Electroplated Diamond Tool H. Gao, T. Zhao, Y.J. Bao, C. Sun and S.X. Lu	222
A Study on Erosion of Alumina Wafer in Abrasive Water Jet Machining Y. Wang, H.T. Zhu, C.Z. Huang, J. Wang, P. Yao and Z.W. Zhang	228

Chapter 4: Grinding Wheel

Optimizing the Dry Grinding Process on the Basis of Bond Materials H. Kitzig, N. Jandaghi, B. Azarhoushang and A. Vesali	237
High Efficiency Abrasive Waterjet Dressing of Diamond Grinding Wheel P. Yao, W. Wei, C.Z. Huang, J. Wang, H.T. Zhu and Z.Y. Zhang	243
An Explorative Study of Fabrication of Al-Based Matrix Diamond Grinding Wheels by Vacuum Evaporative Pattern Casting Q.L. Dai, F.Y. You and C.B. Luo	249
Wafer Grinding of Using Fixed Abrasive Diamond Wheel - Evaluation of Cutting Edge Distribution in Diamond Wheels Y. Ebina, L.B. Zhou, J. Shimizu, T. Onuki and H. Ojima	255
Wear of Diamond Wheel in Groove Grinding of Cemented Carbide - Influences of Speed Ratio and Nitrogen Gas Dissolved Coolant O. Horiuchi, T. Samura, T. Uno, T. Itazu, N. Ito, T. Shibata and M. Masuda	261
Evaluation of Grinding Performance by Mechanical Properties of Super Abrasive Wheel - Relationship between Modulus of Rupture and Critical Grain Holding Power (2nd Report) T. Sawa, N. Nishikawa and Y. Ikuse	267
Investigation on Properties of Magnesia Grinding Wheels Used in Silicon Wafer Grinding B.J. Hao, Z.G. Dong, S. Gao, R.K. Kang and D.M. Guo	273

Chapter 5: High Efficiency Machining

Research on 3D Model Processing Technologies in the Application of Freeform Surface Machining J. Zhu, T. Tanaka and Y. Saito	281
Stress Influence on Corrosion Resistance of Aluminum Alloy Surface Y. Wan, Z. Wang, Z.Q. Liu, Z.L. Jiang and D. Zhang	287
Distribution of the Convection Heat Transfer Coefficients of Grinding Fluids along the Contact Zone in High Speed Grinding T. Jin	292
Performance of Strong Alkali Ion Water in Cutting and Grinding Applications M. Iwai, H. Hashimoto, M. Yamada, H. Yamada and K. Suzuki	298
Study of Grinding Wheel for Polishing Diamond by Dynamic Friction Polishing S.J. Shi, J.Z. Lin, Z.J. Jin, X.G. Guo, P. Zhou and R.K. Kang	304
Influence of Tool Shape and Coating Type on Machined Surface Quality in Face Milling of CFRP T. Furuki, T. Hirogaki, E. Aoyama, H. Kodama and K. Ogawa	310

Chapter 6: Cutting Technology

Machining of Sintered Tungsten Carbide for Die and Mold T. Moriwaki, S. Tsurimoto, K. Osakada and M. Nagata	319
Laboratory Comparison of SMART*CUT Picks With WC Picks W. Shao, X.S. Li, Y. Sun and H. Huang	323
Essential Research in Machining Difficult-to-Machine Materials for Advancing MQL Cutting Technology with a Newly Developed Coated Tool S. Shimada and M. Kohzaki	329
Experimental Verification of End-Milling Condition Decision Support System Using Data-Mining for Difficult-to-Cut Materials H. Kodama, T. Hirogaki, E. Aoyama, K. Ogawa and K. Okuda	334
High Speed Machining Method of Large-Size Precision Freeform Mirror O. Kirino, H. Nakagawa, S. Kirino and H. Kataza	340
A Study on Straightness of Deep Hole in Small-Diameter Drilling of Stainless Steel K. Okuda, T. Yamaguchi, T. Yamamoto, T. Takeda and H. Shizuka	344

Development of Axially Splitting Method for the Pipe Materials with the Cutting Tool E. Nakanishi, M. Hyono and S. Maki	350
Small Hole Drilling for Polyphenylene Sulfide (PPS) - Influence of Depth-of-Cut on Burr Formation M. Nomura, K. Suzuki, Y.B. Wu and M. Fujimoto	355
Investigation Performance of AlCrN Based Coated Broaching Tool in Broaching of Gas Turbine Material X12CrMoWVNbN1011 Z.Q. Liu, M. Chen, C.D. Wang, Q.L. An, C.X. Ge and G.Q. Guo	361
Study on Surface Finish of Carbon Steel by Ultra-Precision Diamond Cutting Y. Kamoi, K. Okuda, H. Shizuka and M. Nunobiki	367
A Study of Ultrasonically Added High Speed Turning for Stainless Steel - The Effects of Ultrasonic Oscillating Direction and Chip Breaker Shape and Material K. Hara, R. Sasaki, T. Koiwa and H. Isobe	373
Investigation of the Surface-Modification Effect by Oil-Immersion Treatment on Carbide Tool H. Shizuka, K. Sakai and K. Iwakura	377
Face Milling of Carbon Fiber Reinforced Plastic Using Poly Crystalline Diamond Tool J. Kusuyama, A. Yui, T. Kitajima and Y. Itoh	383
Cutting Performance of Binder-Less Nano-Polycrystalline cBN Tool K. Harano, K. Arimoto, Y. Ishida and H. Sumiya	389
An Innovative Cooling Method for Grinding Process Based on Heat Pipe Technology J.J. Chen, Y.C. Fu, Q.S. He, W. Zhang and Y.B. Zhu	393
Simulations of Milling Process of Inconel 718 Alloy Based on Three Dimensional Finite Element Models L.J. He, H.H. Su, J.H. Xu and J.B. Fu	399
Wear Characteristics of Binder-Less Nano-Polycrystalline Diamond and Cubic Boron Nitride H. Sumiya and K. Harano	406
Development of PCD Milling Tool for Carbon-Fiber-Reinforced Plastics T. Kitajima, J. Kusuyama, A. Yui, K. Fujii and Y. Itoh	411

Chapter 7: Tribology in Manufacturing

Friction Characteristics with Pin-on-Disc Friction Test on Microstructured Surface Using Whirling Electrical Discharge Texturing V. Lertphokanont, T. Sato, M. Oi, M. Ota, K. Yamaguchi and K. Egashira	417
Tribo-Electrochemical Performance of Polycrystalline Silicon during ECMP Simulating Process W.J. Zhai and J.H. Wang	423
Long-Duration Frictional and Wear Performance of the Diamond/DLC Bilayered Film under Water-Lubricating Condition S.L. Chen, B. Shen and F.H. Sun	429
Tribological Analysis of Oxide Scales during Cooling Process of Rolled Microalloyed Steel Z.Y. Jiang, X.L. Yu, J.W. Zhao, C.L. Zhou, Q.X. Huang, G.Z. Luo and K.Z. Linghu	435
Study on Identification of Contact Stiffness Considering Surface Roughness K. Nakamura and H. Sakamoto	441
Study on the Tribological Property of Bionic Lead Rail Using ABAQUS L.J. Ma, L.C. Gu, Y.Z. Luo, F.W. Wang and X.H. Chen	447
A Wear Simulation of the Fixed Soft Abrasive Film Based on Discrete Element Method Z.Z. Zhou, K.P. Feng and J.L. Yuan	452
Investigation of Grinding Fluid Supply Parameters on Workpiece Surface Integrity S.C. Xiu, X.M. Zhang, A. Jiang, X.L. Shi, S.J. Li and X.P. Li	458

Chapter 8: Micro/Nano Machining

Precision Machining of Parabolic Mirror Made of Low Thermal Expansion Ceramic M. Okada, A. Takagi, H. Suzuki and J. Sugawara	467
--	-----

Synergistic and Strengthening Mechanism of Twin Boundaries under Nanoindentations for Cadmium Telluride Semiconductors H.X. Zhou, N.D. Duan and B. Wang	473
Removal of Ion Irradiation-Induced Affected Layers from Diamond Cutting Tools to Improve Machining Performance N. Kawasegi, K. Ozaki, N. Morita, K. Nishimura and H. Sasaoka	479
Fabrication of Shapes with Overhang Using Micro-Boring Tools K. Egashira, K. Harada, K. Yamaguchi and M. Ota	485
Ultraprecision Micro Grooving on Brass for Surface Wettability Control K. Asakura and J.W. Yan	489
Influence of Processing Parameters on Surface Roughness in Micro Mill-Grinding Aluminium Alloy 6061 Y.D. Gong, C. Wang, J. Cheng, X.L. Wen and G.Q. Yin	495
Experiment Research on Surface Roughness in Micro-Grinding Metal Material Y.D. Gong, X.L. Wen, Z.X. Zhu, J. Cheng, G.Q. Yin and C. Wang	500

Chapter 9: Finishing/Lapping/Polishing

Preliminary Study on Highly Efficient Polishing of 4H-SiC by Utilization of Anodic Oxidation K. Yamamura, K. Hosoya, Y. Imanishi, H. Deng and K. Endo	509
Development of an Advanced Machine Control System in Superfinishing the Automatic Determination of the Suitable Machining Time T. Onishi, K. Ohashi, K. Higashi, T. Iguchi, S. Yamashita, H. Isa and S. Tsukamoto	515
Study on Fixed-Abrasive Lapping SiC Crystal Substrate Based on Diamond Particle J.X. Su, X.M. Zhang, S.F. Fu, S.Z. Fan and Z.L. Liu	520
Precision Shaping Experiment of Ceramic Ball Blank with Oscillating-Plate Lapping Method B.H. Lyu, C.C. Dong, F.F. Zhou, Q.F. Deng, J.L. Yuan and P. Zhao	526
Advanced Abrasive Processes for Manufacturing Prototype Mirror Segments for the World's Largest Telescope D. Walker, G. Davies, T. Fox-Leonard, C. Gray, J. Mitchell, P. Rees, H.Y. Wu, A. Volkov and G.Y. Yu	532
Effect of Cyclic Heating on the Hardened Layer Properties Generated by Plunge Cylindrical Grinding T. Nguyen, M. Liu, L.C. Zhang, Q. Wu and D.L. Sun	539
Grinding Performance of Diamond Grinding Tools for Sapphire Crystal Y. Zhang, S. Gao, R.K. Kang, X.G. Guo and Z.F. Lin	544
Characterization of Cutting Ability of Electroplated Diamond Wire Used for Multi-Wire Saw H.J. Kim, D.Y. Kim, S.J. Lee, H.D. Jeong and H.J. Choi	549
Micro-Cracks Removal on Edge Surface of Thin Glass Sheet Using Magnetorheological Finishing T. Sato, C.W. Kum and S.T. Ng	553
Study on the Flow Pressure of Mass in Centrifugal Disc Finishing Y. Matsumoto, T. Yamaguchi, K. Kitajima, A. Yamamoto and S. Takahashi	559
Research on Performance of Fixed Abrasive Tools of Polishing 6H-SiC Wafers J. Lu, G.Q. Hu, G.Q. Huang, C.F. Fang and X.P. Xu	565

Chapter 10: System Development

Conditioning of Vitrified Bond CBN Grinding Wheels Using a Picosecond Laser A. Zahedi, T. Tawakoli, J. Akbari and B. Azarhoushang	573
Design of Double-Sided Polishing Machine for Functional Crystal Substrate J.S. Yang, X.L. Zhu, Z.G. Dong, R.K. Kang, D.M. Guo and B. Zhang	580
Development of Non-Contact Classifying Systems by Use of Acoustic Levitation T. Inada, L.B. Zhou, J. Shimizu, H. Ojima and T. Ito	586

Computer-Aided Simulation of Dressing Using Diamond Rotary Dresser and Visualization of Dressing Process	
A. Kubo, A.M.M. Sharif Ullah and J. Tamaki	592
Simulation of Chip Formation Behavior during Single Diamond Grains Grinding by CEL Method	
C.W. Dai, J.H. Xu, W.F. Ding, J.B. Dai and Y.C. Fu	598
Development of Rotary Work Table with Constant-Flow Hydrostatic Water Bearing for Large Scale Silicon-Wafer Grinding Machine	
G. Okahata, A. Yui, T. Kitajima, S. Okuyama, H. Saito and A.H. Slocum	604
Development of a Fine Grating on ZnS for a Wideband Spectral Disperser in Characterizing Exoplanets Using Space-Borne Telescopes	
K. Enya, T. Sukegawa, S. Sugiyama, F. Iijima, N. Fujishiro, Y. Ikeda, T. Yoshikawa and M. Takami	610

Chapter 11: Monitoring & Analysis

Sensorless Cutting Force Estimation in Ball-Screw-Driven System Using Triple-Inertia Model	
Y. Yamada, Y. Kakinuma, T. Ito, J. Fujita, M. Sawazaki and M. Sagara	619
Monitoring of End-Mill Temperature with Infrared Thermography and Wireless Tool Holder System	
M. Shindou, R. Matsuda, T. Furuki, T. Hirogaki and E. Aoyama	624
Experimental Study on the Cutting Performance of <i>In Situ</i> Fabricated TiB₂ Toughened TiN-Based Composite Ceramic Tool in Turning Stainless Steel	
H.L. Liu, Q. Shi, C.Z. Huang, L.M. Wang, B. Zou and Z.H. Yang	630
Entire Hardening of Small Thin Plate with a Small Power Semiconductor Laser Considering Plate Deformation	
R. Oda, T. Hirogaki, E. Aoyama and K. Ogawa	636
Investigation of Step Micro-Drilling Motion Based on Modeling of High Speed Spindle Driving Axis on Machine Tools Equipped with Vibration-Proof Mechanism	
T. Yamashita, T. Hirogaki, E. Aoyama, R. Shibata and K. Ogawa	642
Study on a Novel Brazed Diamond Wire with CuSnTi Brazing Filler	
X.H. Zhu, H. Huang, H. Guo, Y.Q. Yu and X.P. Xu	648
A 5-Axis Coordinated CNC Grinding Method for the Flank of a Non-Coaxial Helical Micro-Drill with the Cylinder Grinding Wheel	
Z.Q. Liang, H.C. Jian, X.B. Wang, W.X. Zhao, S.Y. Zhang, Y. Otani and S.Y. Xue	654

Chapter 12: Metrology & Evaluation

Manufacturing Process Evolution Method of Neutron Ellipsoidal Mirror Simulation Using Measured Point-Set	
S. Morita, S. Takeda, M. Furusaka, J. Guo and Y. Yamagata	663
A Study on Fast Geometric Form Measurement of High Precision Balls	
H.Z. Lu, Z.W. Wang, Q.F. Deng, B.H. Lv, F.F. Zhou and J.L. Yuan	669
Development and Practicality of a Scanning Point Autofocus Instrument for High Speed Areal Surface Texture Measurement	
K. Miura, A. Nose, H. Suzuki and M. Okada	675
Influence of Surface Integrity in Silicon Wafer Thickness Measurements by Reflection Spectroscopy	
T. Onuki, R. Ono, H. Ojima, J. Shimizu and L.B. Zhou	681
The Topographic Characterisation of Grinding Wheels – A Proposed Measurement Strategy	
D.L. Butler	686
Estimation of Machining Error in Ball-End Milling of Hemispherical Surface Based on Measured Cutting Force	
K. Shimana, E. Kondo, S. Yamashita, Y. Kawano and N. Kawagoishi	692
Monitoring of Wear Land Width of Diamond Tool Cutting Edge with Large Nose Radius in Ultra-Precision Cutting Using Static Cutting Forces	
E. Kondo, R. Iwamoto and Y. Kobaru	696

Chapter 13: Chemo-Mechanical Polishing

Future Prospects for CMP Equipment - Design Considerations According to Substrate Size and Shape H.D. Jeong, H.J. Kim and H.J. Choi	705
Measuring Surface Topography of a Diamond Wire Using an Image Processing Method A. Sakaguchi, T. Kawashita and S. Matsuo	709
Effect of Surface Profile on the Material Removal Rate Distribution in CMP Process P. Zhou, J.Q. Cai, Z.W. Li, R.K. Kang and Z.J. Jin	715
Chemical Mechanical Polishing of Soft-Brittle Cadmium Zinc Telluride Wafers Using a Developed Environment-Friendly Solution Z.Y. Zhang, B. Wang and Y.X. Song	720
Effectiveness Evaluation of Novel Pad Dressing Method by Flexible Fiber Dresser - Tool Life Evaluation of Flexible Fiber Dresser M. Uneda, N. Takahashi, Y. Arai and T. Fujita	726

Chapter 14: Non-Traditional Machining

Numerical Investigations on the Grinding Forces in Ultrasonic Assisted Grinding of SiC Ceramics by Using SPH Method Z.Q. Liang, Z.Y. Mi, X.B. Wang, T.F. Zhou, Y.B. Wu and W.X. Zhao	735
The Influence of Amplitude on Grinding Force and Surface Roughness in Ultrasonic Assisted Grinding of K9 Glass F.F. Zheng, F.J. Ma, Y.D. Wang, Z.G. Dong and R.K. Kang	741
High-Speed Capturing of Stress Distribution of Workpiece under Ultrasonically Assisted Cutting Condition H. Isobe and K. Hara	747
Effect of Frequency and Amplitude on the Performance of Elliptic Vibration-Assisted Cutting of Fibre-Reinforced Polymer Composites W.X. Xu and L.C. Zhang	753
Smoothed Particle Hydrodynamics Simulations for Ultrasonic Machining of Different Workpiece Materials J.S. Wang, K. Shimada, M. Mizutani and T. Kuriyagawa	758
Modeling and Simulation of Surface Topography Evolution in Electrical Discharge Machining (EDM) T.F. Zhou, L.Z. Ma, Z.Q. Liang and X.B. Wang	764
Wire-EDM Properties of EC-PCD Made up of Boron Doped Diamond Particles W. Chen, S. Ninomiya, S. Nochi, M. Iwai and K. Suzuki	770
Performance of EC-PCD Made of Boron Doped Diamond as an Electrode for EDM of Cemented Carbide W. Chen, M. Iwai, S. Ninomiya and K. Suzuki	776
EDM Machinabilities of EC-PCD Using Ultrasonic Assisted EDM and Bipolar Pulse Current EDM W. Chen, M. Iwai and K. Suzuki	782
Curved Surfaces Forming of Sheet Material by Laser Irradiation K. Kishida, H. Aoyama, N. Mastushita and A. Ushimaru	788
Production of Fe-Al Alloy Coat on Steel Block by Scanning Laser Beam M. Nunobiki, Y. Harada and K. Okuda	794
Ultrasonic Vibration Assisted Grinding of Sintered Dental Zirconia Ceramics: An Experimental Study on Surface Roughness S. Dong, K. Zheng and X.Z. Xiao	800
External Magnetic Field Control during EDM of a Permanent Magnet H. Takezawa, N. Yokote and N. Mohri	806
Development of Ultrasonic Lapping Equipment for Small Holes Finishing J. Liang, R.K. Kang, F.J. Ma, J.T. Liu and Y.B. Yu	812
Experimental Investigation of Copper-Tungsten Electrode Wear in EDM J.W. Yu, L.H. He, X.M. Sheng, W. Duan, S.H. Yin and Z.T. Shang	818

**Proposal of Micro Removal Process with Pulsed Laser Irradiation Based on Form
Generation Theorem**

H. Sakamoto and K. Morioka

825