

© 2017

Comprehensive Materials Finishing

1st Edition

Authors: Saleem Hashmi

Elsevier

The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB
225 Wyman Street, Waltham MA 02451

Copyright © 2017 Elsevier Inc. All rights reserved

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher. Details on how to seek permission, further information about the Publisher's permissions policies and our arrangements with organizations such as the Copyright Clearance Center and the Copyright Licensing Agency, can be found at our website: www.elsevier.com/permissions.

This book and the individual contributions contained in it are protected under copyright by the Publisher (other than as may be noted herein).

Notices

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our understanding, changes in research methods, professional practices, or medical treatment may become necessary.

Practitioners and researchers may always rely on their own experience and knowledge in evaluating and using any information, methods, compounds, or experiments described herein. In using such information or methods they should be mindful of their own safety and the safety of others, including parties for whom they have a professional responsibility.

To the fullest extent of the law, neither the Publisher nor the authors, contributors, or editors, assume any liability for any injury and/or damage to persons or property as a matter of products liability, negligence or otherwise, or from any use or operation of any methods, products, instructions, or ideas contained in the material herein.

Library of Congress Cataloging-in-Publication Data

A catalog record for this book is available from the Library of Congress

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library

ISBN 978-0-12-803249-7

CONTENTS OF ALL VOLUMES

VOLUME 1 – Finish Machining and Net-Shape Forming

Conventional Finish Machining

1.1	Factors Affecting Surface Roughness in Finish Turning	MM Ratnam	1
1.2	Effect of Cutting Variables on Boring Process: A Review	SA Lawal, MB Ndaliman, KC Bala, and SS Lawal	26
1.3	Finish Machining of Hardened Steel	SK Choudhury and S Chinchani	47
1.4	Review of Gear Finishing Processes	NK Jain and AC Petare	93
1.5	Robotic Polishing and Deburring	Fengfeng Jeff Xi, Tianyan Chen, and Shuai Guo	121
1.6	Precision Grinding, Lapping, Polishing, and Post-Processing of Optical Glass	Yaguo Li, Qinghua Zhang, Jian Wang, Qiao Xu, and Hui Ye	154

Advances in Finish Machining

1.7	Techniques to Improve EDM Capabilities: A Review	H Marashi, AAD Sarhan, I Maher, and M Sayuti	171
1.8	Natural Fiber-Reinforced Composites: Types, Development, Manufacturing Process, and Measurement	SM Sapuan, KF Tamrin, Y Nukman, YA El-Shekeil, MSA Hussin, and SNA Aziz	203
1.9	Effect of Electrical Discharge Energy on White Layer Thickness of WEDM Process	I Maher, AAD Sarhan, and H Marashi	231
1.10	Micro-EDM Drilling of Tungsten Carbide Using Microelectrode with High Aspect Ratio to Improve MRR, EWR, and Hole Quality	M Hourmand, AAD Sarhan, MY Noordin, and M Sayuti	267
1.11	Micromachining	MY Ali and WNP Hung	322
1.12	Laser Machining Processes	BS Yilbas	344
1.13	ELID Grinding and EDM for Finish Machining	T Saleh and R Bahar	364

Finishing Process Using Net Forming

1.14	Laser Peening of Metallic Materials	S Gencalp Irizalp and N Saklakoglu	408
1.15	Micro Plastic Part Filling Capabilities through Simulation and Experiment: A Case Study on Micro Gear Shape	M Azuddin, Z Taha, and IA Choudhury	441
1.16	Net-Shape Microfabrication Technique by Micrometal Powder Injection Molding	AA Abdullahi, N Nahar, M Azuddin, and IA Choudhury	466
1.17	Review of Miniature Gear Manufacturing	NK Jain and SK Chaubey	504

VOLUME 2 – Surface and Heat Treatment Processes

2.1	Fundamentals of Heat Treating Metals and Alloys	MK Banerjee	1
2.2	Hardenability of Steel	AK Bhargava and MK Banerjee	50

2.3	Carburizing: A Method of Case Hardening of Steel	MMA Bepari	71
2.4	Surface Hardening by Gas Nitriding	K Farokhzadeh and A Edrissy	107
2.5	Laser Beam Processing for Surface Modifications	BS Yilbas	137
2.6	Surface Induction Hardening	J Barglik and A Smalcerz	154
2.7	Recent Advances in Mechanical Surface Treatment	S Ismail, Q Ahsan, and ASMA Haseeb	171
2.8	Heat Treatment of Commercial Steels for Engineering Applications	MK Banerjee	180
2.9	Heat Treatment of Tool Steels	RA Mesquita, CA Barbosa, and AR Machado	214
2.10	Heat Treatment of Cast Irons	I Chakrabarty	246
2.11	Thermal Treatment for Strengthening Titanium Alloys	A Sinha, S Sanyal, and NR Bandyopadhyay	288
2.12	Heat Treatment of Aluminum Alloys	HMMA Rashed and AKM Bazlur Rashid	337
2.13	Solutionizing and Age Hardening of Aluminum Alloys	G Quan, L Ren, and M Zhou	372
2.14	Heat-Treating Copper and Nickel Alloys	AK Bhargava and MK Banerjee	398
2.15	Cryogenic Treatment of Engineering Materials	T Slatter and R Thornton	421

VOLUME 3 – Surface Coating Processes

3.1	Electroless Plating of Pd Binary and Ternary Alloys and Surface Characteristics for Application in Hydrogen Separation	AM Tarditi, ML Bosko, and LM Cornaglia	1
3.2	Tuning of the Microstructure and Surface Topography of Hot-Dip Galvanized Coatings	SMA Shibli and R Manu	25
3.3	Surface Finish Coatings	P Sahoo, SK Das, and J Paulo Davim	38
3.4	Residual Stresses in Thermal Spray Coating	AFM Arif, KS Al-Athel, and J Mostaghimi	56
3.5	Laser Texturing of Materials and Surface Hydrophobicity	BS Yilbas	71
3.6	Surface Texture Properties of Co-Ni Alloys Formed with Unipolar and Bipolar Plating	J Vazquez-Arenas, I Romero-Ibarra, RH Lara, and FS Sosa-Rodríguez	86
3.7	HVOF Coating of Nickel Based Alloys: Surface and Mechanical Characteristics	BS Yilbas	96
3.8	Laser-Based 3D Printing and Surface Texturing	A Selimis and M Farsari	111
3.9	Hydrophobicity and Surface Finish	A Owais, M Khaled, and BS Yilbas	137
3.10	Atomizers and Finish Properties of Surface Coatings	R Ray and P Henshaw	149
3.11	Gas Nitriding of H13 Tool Steel Used for Extrusion Dies: Numerical and Experimental Investigation	SS Akhtar, AFM Arif, and BS Yilbas	158
3.12	Hot-Dip Galvanizing Process	F Ozturk, Z Evis, and S Kilic	178
3.13	Finishing and Post-Treatment of Thermal Spray Coatings	MM Verdian	191
3.14	High Velocity Oxy-Fuel Spraying and Surface Finish	H Singh, M Kaur, and N Bala	207
3.15	Electroless Plating as Surface Finishing in Electronic Packaging	MA Azmah Hanim	220
3.16	Hard Coatings on Cutting Tools and Surface Finish	H Caliskan, P Panjan, and C Kurbanoglu	230
3.17	Topological Evaluation of Surfaces in Relation to Surface Finish	P Demircioglu	243

3.18	Evaluation of Surface Finish Quality Using Computer Vision Techniques	<i>I Bogrekci and P Demircioglu</i>	261
3.19	Effect of Surface Roughness on Wetting Properties	<i>H Mojiri and M Aliofkhazraei</i>	276
3.20	Surface Preparation and Adhesion Tests of Coatings	<i>M Jokar and M Aliofkhazraei</i>	306
3.21	Powder Metallurgical Processing of NiTi Using Spark Plasma Sintering	<i>K McNamara, J Butler, AA Gandhi, and SAM Tofail</i>	336
3.22	Spark Plasma Sintering of Lead-Free Ferroelectric Ceramic Layers	<i>M Karimi-Jafari, K Kowal, E Ul-Haq, and SAM Tofail</i>	347
3.23	Electrochemical Processing and Surface Finish	<i>NK Jain and S Pathak</i>	358
	Index		381

CONTENTS OF VOLUME 1

Preface	xvii
Introduction to Finish Machining and Net-Shape Forming	xix

VOLUME 1 – Finish Machining and Net-Shape Forming

Conventional Finish Machining

1.1	Factors Affecting Surface Roughness in Finish Turning	<i>MM Ratnam</i>	1
1.2	Effect of Cutting Variables on Boring Process: A Review	<i>SA Lawal, MB Ndaliman, KC Bala, and SS Lawal</i>	26
1.3	Finish Machining of Hardened Steel	<i>SK Choudhury and S Chinchanihar</i>	47
1.4	Review of Gear Finishing Processes	<i>NK Jain and AC Petare</i>	93
1.5	Robotic Polishing and Deburring	<i>Fengfeng Jeff Xi, Tianyan Chen, and Shuai Guo</i>	121
1.6	Precision Grinding, Lapping, Polishing, and Post-Processing of Optical Glass	<i>Yaguo Li, Qinghua Zhang, Jian Wang, Qiao Xu, and Hui Ye</i>	154

Advances in Finish Machining

1.7	Techniques to Improve EDM Capabilities: A Review	<i>HI Marashi, AAD Sarhan, I Maher, and M Sayuti</i>	171
1.8	Natural Fiber-Reinforced Composites: Types, Development, Manufacturing Process, and Measurement	<i>SM Sapuan, KF Tamrin, Y Nukman, YA El-Shekeil, MSA Hussin, and SNA Aziz</i>	203
1.9	Effect of Electrical Discharge Energy on White Layer Thickness of WEDM Process	<i>I Maher, AAD Sarhan, and H Marashi</i>	231
1.10	Micro-EDM Drilling of Tungsten Carbide Using Microelectrode with High Aspect Ratio to Improve MRR, EWR, and Hole Quality	<i>M Hourmand, AAD Sarhan, MY Noordin, and M Sayuti</i>	267
1.11	Micromachining	<i>MY Ali and WNP Hung</i>	322
1.12	Laser Machining Processes	<i>BS Yilbas</i>	344
1.13	ELID Grinding and EDM for Finish Machining	<i>T Saleh and R Bahar</i>	364

Finishing Process Using Net Forming

1.14	Laser Peening of Metallic Materials	<i>S Gencalp Irizalp and N Saklakoglu</i>	408
1.15	Micro Plastic Part Filling Capabilities through Simulation and Experiment: A Case Study on Micro Gear Shape	<i>M Azuddin, Z Taha, and IA Choudhury</i>	441
1.16	Net-Shape Microfabrication Technique by Micrometal Powder Injection Molding	<i>AA Abdullahi, N Nahar, M Azuddin, and IA Choudhury</i>	466
1.17	Review of Miniature Gear Manufacturing	<i>NK Jain and SK Chaubey</i>	504