Transport in Laser Microfabrication

Emphasizing the fundamentals of transport phenomena, this book provides researchers and practitioners with the technical background they need to understand laser-induced microfabrication and materials processing at small scales. It clarifies the laser materials coupling mechanisms, and discusses the nanoscale confined laser interactions that constitute powerful tools for top-down nanomanufacturing. In addition to analyzing key and emerging applications for modern technology, with particular emphasis on electronics, advanced topics such as the use of lasers for nanoprocessing and nanomachining, the interaction with polymer materials, nanoparticles and clusters, and the processing of thin films are also covered.

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Transport in Laser Microfabrication: Fundamentals and Applications

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CAMBRIDGE
UNIVERSITY PRESS

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University Printing House, Cambridge CB2 8BS, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314-321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi - 110025, India

103 Penang Road, #05-06/07, Visioncrest Commercial, Singapore 238467

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org
Information on this title: www.cambridge.org/9780521821728

First published 2009

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

ISBN 978-0-521-82172-8 Hardback

To Mary, Vassiliki, and Alexandra

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Cambridge University Press
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Preface

Lasers are effective material-processing tools that offer distinct advantages, including choice of wavelength and pulse width to match the target material properties as well as one-step direct and locally confined structural modification. Understanding the evolution of the energy coupling with the target and the induced phase-change transformations is critical for improving the quality of micromachining and microprocessing. As current technology is pushed to ever smaller dimensions, lasers become a truly enabling solution, reducing thermomechanical damage and facilitating heterogeneous integration of components into functional devices. This is especially important in cases where conventional thermo-chemo-mechanical treatment processes are ineffective. Component microfabrication with basic dimensions in the few-microns range via laser irradiation has been implemented successfully in the industrial environment. Beyond this, there is an increasing need to advance the science and technology of laser processing to the nanoscale regime.

The book focuses on examining the transport mechanisms involved in the laser–material interactions in the context of microfabrication. The material was developed in the graduate course on *Laser Processing and Diagnostics* I introduced and taught in Berkeley over the years. The text aims at providing scientists, engineers, and graduate students with a comprehensive review of progress and the state of the art in the field by linking fundamental phenomena with modern applications.

Samuel S. Mao of the Lawrence Berkeley National Laboratory and the Mechanical Engineering Department of UC Berkeley contributed major parts of Chapters 5, 6, and 9. I wish to acknowledge the contributions of all my former and current students throughout this text. Hee K. Park's, David J. Hwang's, and Seung-Hwang Ko's input extended beyond their graduate studies to post-doctoral stints in my laboratory. I am grateful to Gerald A. Domoto of Xerox Co. for introducing me to an interesting laser topic that evolved into my doctoral thesis at Columbia University. Dimos Poulikakos of the ETH Zürich talked me into starting this book project when I was on sabbatical in Zurich in 2000. His contributions in collaborative work form a key part of the text. I thank Professor Jean M. J. Fréchet of the UC Berkeley College of Chemistry for his contributions as well as Costas Fotakis of the IESL FORTH, Greece, and Dieter Bäuerle of Johannes Kepler University, Austria, for their support and input.

I am indebted to the NSF, DOE, and DARPA for funding work this book benefited from. The expert help of Ms. Ja Young Kim in preparing the artwork was key in completing this book.

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