

Thin Films

Non-Crystalline Films for Device Structures

Edited by

Maurice H. Francombe

*Department of Physics and Astronomy
Georgia State University
Atlanta, Georgia*

VOLUME 29



ACADEMIC PRESS

A Division of Harcourt, Inc.

San Diego San Francisco New York Boston
London Sydney Tokyo

B 9 f 1 0 1 6 0 1 2 9



This book is printed on acid-free paper. ☺

Compilation copyright © 2002 by ACADEMIC PRESS

All rights reserved.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the publisher.

The appearance of the code at the bottom of the first page of a chapter in this book indicates the Publisher's consent that copies of the chapter may be made for personal or internal use of specific clients. This consent is given on the condition, however, that the copier pay the stated per copy fee through the Copyright Clearance Center, Inc. (222 Rosewood Drive, Danvers, Massachusetts 01923), for copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Law. This consent does not extend to other kinds of copying, such as copying for general distribution, for advertising or promotional purposes, for creating new collective works, or for resale. Copy fees for pre-2002 chapters are as shown on the title pages. If no fee code appears on the title page, the copy fee is the same as for current chapters.

1079-4050/2002 \$35.00.

Explicit permission from Academic Press is not required to reproduce a maximum of two figures or tables from an Academic Press chapter in another scientific or research publication provided that the material has not been credited to another source and that full credit to the Academic Press chapter is given.

The articles in this book are selected from the Academic Press multi-volume work titled *Handbook of Thin Film Materials*, edited by Hari S. Nalwa, and are uniquely arranged to focus on current advances in surface science.

Academic Press

A division of Harcourt, Inc.

525 B Street, Suite 1900, San Diego, California 92101-4495, USA

<http://www.academicpress.com>

Academic Press

Harcourt Place, 32 Jamestown Road, London NW1 7BY, UK

<http://www.academicpress.com>

International Standard Book Number: 0-12-533029-4

International Standard Serial Number: 1079-4050

PRINTED IN THE UNITED STATES OF AMERICA

01 02 03 04 05 CO 9 8 7 6 5 4 3 2 1

Contents

Contributors	vii
Preface	ix

Ultrathin Gate Dielectric Films for Si-Based Microelectronic Devices

C. Krug and I. J. R. Baumvol

1.1. Introduction	1
1.2. Requirements of Ultrathin Gate Dielectric Films	6
1.3. Ultrathin Gate Dielectric Film Processing	6
1.4. Characterization of Ultrathin Gate Dielectric Films	16
1.5. Hydrogen and Ultrathin Gate Dielectric Films	45
1.6. Silicon Oxide Gate Dielectric Films	52
1.7. Silicon Oxynitride Gate Dielectric Films	82
1.8. Alternative (High- <i>k</i>) Gate Dielectric Films	104
1.9. Final Remarks	122
Acknowledgments	122
References	123

Electrochemical Passivation of Si and SiGe Surfaces

J. Rappich and Th. Dittrich

2.1. Introduction	135
2.2. In Situ Characterization of Surface Bond Configurations and Electronic Surface States	137
2.3. Electrochemically Hydrogenated Si Surfaces	159
2.4. Hydrogenated Porous Silicon	182
2.5. Thin Anodic Oxides on Si	200
2.6. Thick Anodic Oxides on Si	224
2.7. Enhanced Passivation of SiGe by Anodic Oxidation	233
Acknowledgments	249
References	249

Index	261
-----------------	-----