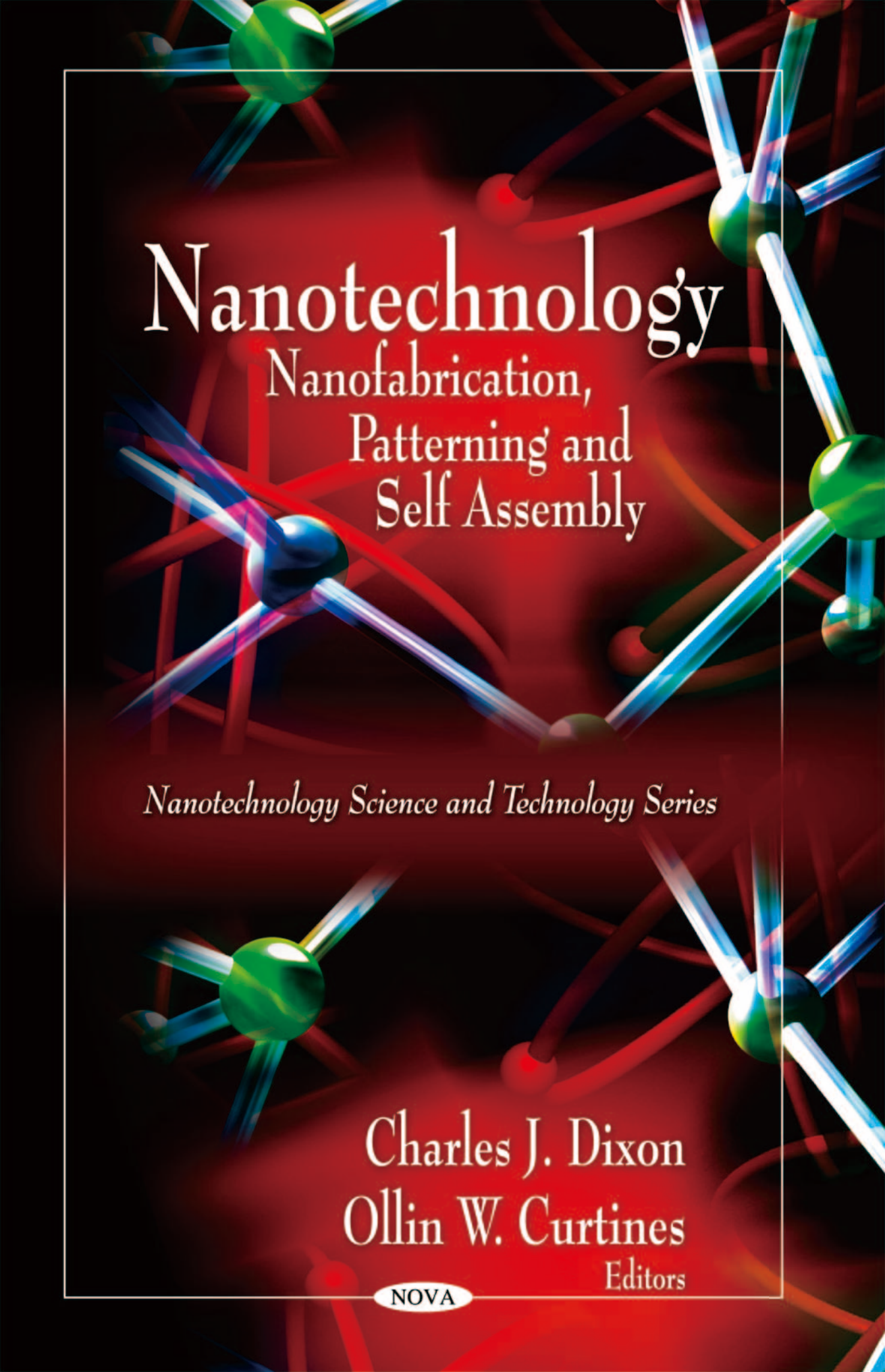
Nanotechnology
Nanofabrication,
Patterning and
Self Assembly
Nanotechnology Science and Technology Series
Charles J. Dixon
Ollin W. Curtines
Editors
NOVA

NANOTECHNOLOGY SCIENCE AND TECHNOLOGY SERIES

NANOTECHNOLOGY: NANOFABRICATION, PATTERNING AND SELF ASSEMBLY

CHARLES J. DIXON
AND
OLLIN W. CURTINES
EDITORS

Nova Science Publishers, Inc.
New York

LIBRARY OF CONGRESS CATALOGING-IN-PUBLICATION DATA

Nanotechnology : nanofabrication, patterning, and self assembly / editors, Charles J. Dixon and Ollin W. Curtines.
p. cm.
Includes index.
ISBN 978-1-61761-771-3 (Ebook)
1. Nanostructured materials. 2. Nanotechnology. I. Dixon, Charles J. II. Curtines, Ollin W.
TA418.9.N35N3574 2009
620'.5--dc22

2009004990

Published by Nova Science Publishers, Inc. † New York

CONTENTS

In: Nanotechnology… ISBN: 978-1-60692-162-3
Editors: C.J. Dixon and O.W. Curtines, pp. 3-50

Chapter 1

ELECTROCHEMICAL NANOFABRICATION

Di Wei
Nokia Research Centre, c/o Nanoscience Centre
at University of Cambridge,
11 JJ Thomson Avenue, CB3 0FF, Cambridge, UK

Abstract

Nano- and micro-fabrications have been largely used in the applications such as integrated circuits, micro/nano electro-mechanical systems (M/NEMS), micro-optics and countless others. The methodology of nanofabrication can be divided into two types, top-down and bottom-up processes, which themselves can be further divided. Top-down process refers to approaching the nanoscale from the top (or larger dimensions), such as lithography, nanoimprinting, scanning probe and E-beam technique etc.. In bottom-up fabrication processes, the nanotechnology process builds nanoscale artifacts from the molecular level up, through single molecules or collections of molecules that agglomerate or self-assemble. Using a bottom-up approach, such as self-assembly enables scientists to create larger and more complex systems from elementary subcomponents (e.g. atoms and molecules). In general, top-down processes that transfer minute patterns onto material are more matured than bottom-up processes. An exception is epitaxial processes that create layers through layer-by-layer growth with registry at the atomic level.

Electrodeposition has actually been used for decades to form high quality, mostly metallic, thin films. It has recently been shown that high quality copper interconnects for ultra large scale integration chips can be formed electrochemically on Si wafer [1;2]. Electrodeposition has thus been shown compatible with state of the art semiconductor manufacturing technology. The largest semiconductor companies, for example, IBM, Intel, AMD, Motorola etc. are installing wafer-electroplating machines on their fabrication lines [1]. The electrodeposition of Cu with the line width 250 nm was used in the mass-production of micro-processor Pentium III in 1998. In 2003, the line width of the CPU was reduced to 130 nm in Pentium IV. Electrochemistry was largely used in chip fabrication [3] and the packaging of micro-electronics [4]. However, comparing with other nanofabrication techniques, electrochemical nanofabrication is still a maiden area which needs further development and fulfilment.