Engineering of Polymers and Chemical Complexity

Volume 1 Current State of the Art and Perspectives

Editors

LinShu Liu, PhD Antonio Ballada, PhD





ENGINEERING OF POLYMERS AND **CHEMICAL** COMPLEXITY

Volume I: Current State of the Art and Perspectives



Reviewers and Advisory Board Members



Apple Academic Press Inc.
3333 Mistwell Crescent
Oakville, ON L6L 0A2
Canada

Apple Academic Press Inc. 9 Spinnaker Way Waretown, NJ 08758 USA

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Exclusive worldwide distribution by CRC Press, a member of Taylor & Francis Group

No claim to original U.S. Government works Printed in the United States of America on acid-free paper

International Standard Book Number-13: 978-1-926895-86-4 (Hardcover)

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Library of Congress Control Number: 2014933152

Library and Archives Canada Cataloguing in Publication

Engineering of polymers and chemical complexity.

Includes bibliographical references and index.

Contents: Volume I. Current state of the art and perspectives/edited by LinShu Liu, PhD, and Antonio Ballada, PhD; Gennady E. Zaikov, DSc, and A. K. Haghi, PhD, Reviewers and Advisory Board Members -- Volume II. New approaches, limitations and control / edited by Walter W Focke, PhD and Prof. Hans-Joachim Radusch.

ISBN 978-1-926895-86-4 (v. 1: bound).--ISBN 978-1-926895-87-1 (v. 2: bound)
1. Polymers. 2. Polymerization. 3. Chemical engineering. 4. Nanocomposites (Materials).
I. Liu, LinShu, editor of compilation II. Ballada, Antonio, editor of compilation III. Focke,
W. W. (Walter Wilhelm), editor of compilation IV. Radusch, Hans-Joachim, editor of compilation V. Title: Current state of the art and perspectives. VI. Title: New approaches, limitations and control.

TP156.P6E54 2014

668.9

C2014-901112-1

Apple Academic Press also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic format. For information about Apple Academic Press products, visit our website at **www.appleacademicpress.com** and the CRC Press website at **www.crcpress.com**

ENGINEERING OF POLYMERS AND CHEMICAL COMPLEXITY

Volume I: Current State of the Art and Perspectives

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LIST OF ABBREVIATIONS

ABC Atomistic-based continuum

BD Brownian dynamics
CNT Carbon nanotube
CV Cyclic voltammetry
CXR Cyclohexane regain
DA Dirt adherence

DFT Density functional theory
DMA Dynamic mechanical analysis
DPD Dissipative particle dynamics
DSC Differential scanning calorimetery

EP Electrostatic properties

EPR Electron paramagnetic resonance

FEM Finite element method

FP Ferrocene-containing polymers

FTIR Fourier transform infrared spectroscopy

FTT Fire testing technology

HVSEM High vacuum scanning electron microscopy

LB Lattice Boltzmann LbL Layer-by-Layer

LVSEM Low vacuum scanning electron microscopy

MC Monte Carlo

MD Molecular dynamics

MIC Minimum inhibitory concentration

MM Molecular mechanics

MWCNT Multi-walled carbon nanotube

PEBBLE Photonic explorers for bioanalyse with biologically localized

embedding system

PMC Polyelectrolyte microcapsules
PXRD Powder X-ray diffraction
RVE Representative volume element
SEM Scanning electron microscopy

SUSHI Simulation utilities for soft and hard interfaces
TDGL Time-dependent Ginzburg-Landau method

TEM Transmission electron microscopy
TGA Thermogravimetric analysis
XRD X-Ray powder diffraction

ZFC Zero-field cooled

PRFFACE

This book provides a broad overview on current studies in the engineering of polymers and chemicals complexity of various origins, on scales ranging from single molecules and nano-phenomena to macroscopic chemicals. The book consists of 15 chapters that survey the current progress in particular research fields. The chapters, prepared by leading international experts, yield together a fascinating picture of a rapidly developing research discipline that brings chemical engineering to new frontiers.

The aim of Chapter 1 is to demonstrate conditions under which communicating pores are formed enabling high permeability of PHEMA scaffolds that is crucial for future cell seeding. Thermal properties of the polypropylene/multi-walled carbon nanotube composites are studied in Chapter 2. Chapter 3 explains that the polymeric nanocomposites could be considered as polymers filled with nanoparticles that interact with the polymeric matrix on the molecular level, contrary to the macrointeraction in composite materials. Mentioned nanointeraction results in high adhesion hardness of the polymeric matrix to the nanoparticles. New magnetic nanomaterials have been synthesized from ferrocene-containing polyphenylenes in Chapter 4. In Chapter 5 the stability of polymeric products to oxidizing and hydrolytic destructions is investigated in detail.

The aim of Chapter 6 is to demonstrate a particular example of a sensor system, which combines catalytic activity for urea and, at the same time, enabling monitoring enzymatic reaction by optical recording. The proposed sensor system is based on multilaver polyelectrolyte microcapsules containing urease and a pH-sensitive fluorescent dye, which translates the enzymatic reaction into a fluorescently registered signal. A study on activity of liposomal antimicrobic preparations is reported in Chapter 7. Polyelectrolyte ensym-bearing microdiagnosticum as a new step in clinical-biochemistry analysis is presented in Chapter 8 of this book. A detailed review of mathematical modeling and experimental case studies on nanofibers and CNTs is presented in Chapter 9. In Chapter 10, the orientation controlled immobilization strategy for β-galactosidase on alginate beads is investigated. Chapter 11 reports a study on the preparation, characterization, and evaluation of water-swellable hydrogel via grafting cross-linked polyacrylamide chains onto gelatin backbone by free radical polymerization. The aim of this chapter is to increase the water holding capacity of gelatin to wide its applications as soil conditioners. Chapter 12 presents an experimental study on the chemical composition and anatomic structure of polluted higher aquatic plants by making use of combined physical methods of characterization band Fourier transform infrared spectroscopy, scanning electron microscopy, and X-ray microanalysis. Several case studies presented in Chapter 13 on complexities in nanomaterials. In Chapter 14 a detailed discussion presented on microstructures of graphite. In the last chapter, theoretical treatment of disperse nanofiller aggregation

xx Preface

process in butadiene-styrene rubber matrix within the frameworks of irreversible aggregation models was carried out.

This book provides innovative chapters on the growth of educational, scientific, and industrial research activities among chemists, biologists, and polymer and chemical engineers and provides a medium for mutual communication between international academia and the industry.

- LinShu Liu, PhD, and Antonio Ballada, PhD

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CHAPTER 1

HYDROGEL-BASED SUPPORTS: DESIGN AND SYNTHESIS

D. HORÁK and H. HLÍDKOVÁ

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