

Polymers and Other Advanced Materials

Emerging Technologies and Business Opportunities

Edited by

Paras N. Prasad

*State University of New York at Buffalo
Buffalo, New York*

James E. Mark

*University of Cincinnati
Cincinnati, Ohio*

and

Ting Joo Fai

*Standard and Industrial Research Institute of Malaysia
Kuala Lumpur, Malaysia*

Plenum Press • New York and London

Polymers and other advanced materials : emerging technologies and business opportunities / edited by Paras N. Prasad, James E. Mark, and Ting Joo Fai.

p. cm.

"Proceedings of the Third International Conference on Frontiers of Polymers and Advanced Materials, held January 16-20, 1995, in Kuala Lumpur, Malaysia"--T.p. verso.

Includes bibliographical references and index.

ISBN 0-306-45210-3

1. Polymers. 2. Materials. I. Prasad, Paras N. II. Mark, James E., 1934- III. Ting, Joo Fai. IV. International Conference on Frontiers of Polymers and Advanced Materials (3rd : 1995 : Kuala Lumpur, Malaysia)

TA455.P58P6954 1996

620.1'92--dc20

95-48884

CIP

Proceedings of the Third International Conference on Frontiers of Polymers and Advanced Materials, held January 16-20, 1995, in Kuala Lumpur, Malaysia

ISBN 0-306-45210-3

© 1995 Plenum Press, New York
A Division of Plenum Publishing Corporation
233 Spring Street, New York, N. Y. 10013

10 9 8 7 6 5 4 3 2 1

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Printed in the United States of America

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PREFACE

This book continues the tradition of providing the scientific community with information on some of the most important advances reported at a series of conferences on Frontiers of Polymers and Advanced Materials. The particular meeting covered in this proceedings volume was held in Kuala Lumpur, Malaysia, from January 16th through the 20th, 1995. It follows earlier proceedings, also published by Plenum, for a conference in New Delhi in 1991, and another in Jakarta in 1993. All of these conferences focused on the most recent and important advances in a wide range of carefully chosen subject areas dealing with advanced materials and new technologies.

The Malaysia Conference was organized by the Malaysian Ministry of Science, Technology and Environment; Malaysian Industry-Government Group for Higher Technology; Standards and Industrial Research Institute of Malaysia; State University of New York at Buffalo; and Malaysian Plastic Manufacturers Association. The stated goals of the conference were:

- To highlight advances and new findings in Polymers and Advanced Materials
- To bring together leading international scientists, engineers and top level industrial management for discussions on the current status of advanced materials, new technologies and industrial opportunities
- To foster global communication in polymers and advanced materials technology.

The Malaysian conference covered by these proceedings emphasized "composites and blends", "high-performance materials", "materials for photonics", "materials for electronics", "biomaterials", "recycling of materials", "sol-gel and processed materials", "advanced materials from natural products", and "multifunctional and smart materials". There was also a separate symposium on "business opportunities".

The success of the conference can be gauged, in part, from the number of attendees and their origins: a total of approximately 350, with 200 having come from more than 30 countries other than the host, Malaysia. The Malaysian participants were well aware of the importance of new materials and of emerging new technologies in various high-technology areas such as microelectronics, aerospace, and telecommunications. Their stated interests were certainly consistent with the conference's goal of providing researchers and industrialists immediate access to advances and developments within the international research community.

The conference included general plenary lectures, given by high-level managers coming from important polymer industries, or from industries interested in the use of polymers in electronics or optoelectronics. Some are included here as part of this proceedings volume. The general emphasis was on the use of polymers and new organic materials over a very wide range of industrial applications.

The international sponsoring agencies for this conference were AKZO Nobel, Cheil Industries, Dow Corning, Hoechst-Celanese, International Institute of Theoretical Physics/UNESCO, Lucky, Ltd., US Office of Naval Research, TORAY Industries, US AID, US Army Research Office (Far East, ARO-FE), US Naval Regional Contracting Centre, and Unitika, Ltd. The Asian Office of Aerospace Research and Development, United States Air Force Office of Scientific Research sponsored the symposium "Materials for Photonics". There were also a number of local sponsoring agencies, and their support added greatly to the success of the conference. We wish to express our gratitude to the Honorable Datuk Law Hieng Ding, Minister of Science, Technology and Environment, Malaysia who played a valuable role as the honorary chairman and to Dato' Dr. Ahmad Tajuddin Ali as the conference chairman from Malaysia. Our gratitude is also to our co-chairman, Professor Frank Karasz, and Dr. Chong Chok Ngee of the National Organizing Committee for their effort in the success of this conference. Finally, we thank Professor D. A. Cadenhead, Professor A. J. Epstein, Dr. A. Guzdar, Professor S. J. Huang, Dr. F. Kajzar, Dr. D. Kaplan, Professor F. E. Karasz, Professor I. C. Khoo, Professor R. M. Laine, Professor J. E. Mark, Professor N. Ogata, and Professor G. G. Wallace for serving as the various symposium chairpersons and for their efforts in the selection of speakers.

The editors of this volume will consider themselves amply rewarded if the information provided not only brings interested readers up to date in these important subject areas, but encourages them to contribute to future advances as well.

P. N. Prasad
Buffalo, New York

J. E. Mark
Cincinnati, Ohio

J. F. Tung
Kuala Lumpur, Malaysia

CONTENTS

COMPOSITES AND BLENDS

Composite Applications in Commercial Transport Aircraft	1
John T. Quinlivan and Henry R. Fenbert	
High Mechanical Performance Composites and Design of Composite Structures	7
Jean-Marie Berthelot	
Preparation of Novel Polyamide 6 Blends Made by Reactive Extrusion Compounding	19
J. F. Tung and P. R. Hornsby	
Preparation and Properties of Hairy-Rod Molecular Composites	27
Jin Chul Jung, Sang-Bong Park, Heesub Kim, Sung Hwan Ji and Wang-Cheol Zin	
Vibration Control in Fibre-Reinforced Composite Structures	37
A. R. Roslan and M. S. Leong	
Fatigue Behavior of Long Fiber Reinforced Polyamide and Polycarbonate Composites Under Tension-Tension Loading	53
C. C. M. Ma, S. H. Lin and N. H. Tai	
Poly(arylene ether ketone) Chemistry: Recent Advances in Synthesis and Applications	69
K. Dahl and V. Jansons	
Morphology Modification of Polymer Blend Films by Electric Field	83
Jong-Wook Ha and Seung-Man Yang	
Reactive Blending of PET and Liquid Crystalline Polymer	93
C. I. Hwang, S. B. Kil and O. O. Park	
Miscibility of Polymer Blends at the Air/Water Interface	101
Chang Sik Ha, Won-Ki Lee, Won-Jei Cho and Hiroo Nakahara	
Optimization in Thermoplastic Prepregging System	109
M. Nasir, H. Ishak and B. Azahari	

Thermal Properties of NR-LLDPE Thermoplastic Blends	117
Ibrahim Abdullah, Sahrim Ahmad and Che Som Sulaiman	
Flow and Fracture Behavior of Sand-Reinforced Low Density Polyethylene during Tensile Testing	125
Abdelrazek Y. Kandeil and Rouchdy R. Zahran	
Effect of Hygrothermal Aging on the Tensile Properties of Short Glass Fiber Reinforced Nylon 6.6	133
Z. A. Mohd Ishak, U. S. Ishiaku and C. P. Tan	
Finite Element Analysis of Plastic Yielding at a Circular Hole in a Laminated Composite Plate Based on Refined Plate Theory	141
Tasneem Pervez	
Heat Treatment Behavior of Metal Matrix Composites	159
Azmi Rahmat, Shamsul Baharin and P. R. Khangaonkar	
Biodegradable Polymer Blends	169
Mohammed Yasin, Allan J. Amass and Brian J. Tighe	

HIGH PERFORMANCE MATERIALS

Improved Mechanical Properties of Polymer Films Dried from the Swollen State in Uniaxial and Biaxial States of Strain	177
J. E. Mark	
Recent Developments and Perspectives in ABS Resin	185
Hyungsu Kim and Sang S. Woo	
Recent Advances in Polypropylene-Based Materials, Properties and Applications	189
T. Simonazzi and J. C. Haylock	
Surface Modification of Silicones	201
Michael J. Owen and Jennifer L. Fritz	
Design of Side-Chain Liquid Crystalline Polymers	213
Yusuke Kawakami	
Polymers in Space Environments	221
V. N. Krishnamurthy	
Advanced Turbulent Drag Reducing and Flocculating Materials Based on Polysaccharides	227
Ram Prakash Singh	

Origin of Crystallinity in Block and Random Terephthalate-Sebacate Copolymers as Studied Using Monte Carlo Methods	251
Tarek M. Madkour	
Structural Design Synthesis of Marine Crafts Using FRP Materials in Sandwich Constructions	263
Abdul Razak Bin Mohd Sidek and Mohd Ramzan Bin Mainal	
The Effect of Fluorine Gas Mixtures on the Surface Properties of Polyolefins	273
Francois J. du Toit, Ronald D. Sanderson and Jakobus B. Wagener	
Synthesis and Biological Activities of Endo-3,6-Epoxy-1,2,3,6- Tetrahydrophthalimide and Its Polymers	291
Gi Cheol Kim, Jin Gon Jeong, Neung Ju Lee, Chang Sik Ha and Won Jei Cho	

MATERIALS FOR ELECTRONICS

Optic Characterization of Oligo-Thiophene Multilayers	297
M. Muccini, R. F. Mahrt, R. Hennig, U. Lemmer, H. Bassler, F. Biscarini, R. Zamboni and C. Taliani	
The Present State of, and Future Prospects for, Large-Area Full-Color DC PDPs	303
Junro Koike	
Dielectric and Dipole Moment Study of Charge Transfer Complexes of Poly(N-Vinylcarbazole) and 2,4,7-Trinitro-9-Fluorenone	311
Mohammed Fiaz	
Comparative Study of the Raman Spectra of Different Forms of Polyanilines	317
G. Louarn, S. Quillard and S. Lefrant	
The Lowest Excited States in Oligo(Phenylenevinylene)s: A Theoretical Investigation of Optical Absorption Spectra and Geometry Relaxation Phenomena	327
J. Cornil, D. Beljonne, Z. Shuai, D. D. C. Bradley and J. L. Bredas	
Chemical and Electronic Structure of Interfaces with Conjugated Polymers: Systems of Interest in Molecular Electronics Applications	335
G. Iucci, K. Xing, C. W. Spangler, M. Logdlund, A. Holmes and W. R. Salaneck	

Synthesis of Poly(2-methoxy-5-methyl-1,4-phenylenevinylene); Substituent Effects on the Electrical and Nonlinear Optical Properties	347
Jeong-Ik Lee, Hong-Ku Shim, Geon Joon Lee and Dongho Kim	
A Soluble and Electrically Conducting Polymer System Incorporating Thiophene and Acetylenic Moieties	355
Abhijit Sarkar, Leong L. San, Hardy S. O. Chan and Siu C. Ng	
Limiting Factors in Operation and Fabrication of Organic Electroluminescence Devices	361
Jan Kalinowski	
Electrical Properties of Impurity Doped Ion Conducting Polymers	369
S. Radhakrishna and S. Anandan	
The Optical Properties and the A.C. Conductivity of the Gamma-Irradiated ABS Material	379
M. E. Kassem and M. R. Issa	
Processible Aromatic Polyamides Derived from 2,5-BIS(4-Aminophenyl-3,4- Diphenyl Thiophene and Aromatic Diacid Chlorides	385
Won-Kyu Lee, Kwang-Sup Lee, Hyun Hoon Song and Soo-Min Lee	

MATERIALS FOR PHOTONICS

Polymer Dispersed Liquid Crystals for Electronic Applications	393
J.C. Dubois, L. Bouteiller, P. Le Barny and P. Robin	
Optical Devices Utilizing Nonlinear Organic Materials	405
J. R. Davy, S. R. Rees, J. Staromlynska, J. A. Hermann, M. P. Gillyon, T. J. McKay and P. B. Chapple	
Nonlinear Electro-Optical and Holographic Storage Effect in Fullerene-Doped Nematic Liquid Crystal Film	421
I. C. Khoo	
Patterning of Polydiacetylene Waveguides by Means of Argon Laser Photobleaching	433
L. Palchetti, D. Grando, E. Giorgetti, S. Sottini and Qu Li	
Polymers as Multi-role Materials for Photonics Technology	441
Paras N. Prasad	

Dichromated Polyvinyl Alcohol for Real-Time Hologram Recording: A Study on the Effect of Some External Electron Donors and Humidity	451
M. Barikani, E. Simova and M. Kavehrad	
Highly Efficient Liquid Crystal Polymers for Quadratic Nonlinear Optics	465
D. Gonin, B. Guichard, C. Noel and F. Kajzar	
Novel Electro-Optic Polyimide and Polyamide Side Chain and Main Chain Polymers	485
P. Gunter, P. Pretre, P. Kaatz, Ch. Weder, P. Neuenschwander and U. W. Suter	
Bulk Phase-Matched Second-Harmonic Generation in Drawn and Poled Polymers	493
X. T. Tao, H. Ukuda, T. Watanabe and S. Miyata	
Synthesis and Processing Relevant to Systems Integration of Nonlinear Optical Materials	503
A. W. Harper, A. Hubbel, J. Laquindanum, Y. Ra and L. R. Dalton	
Optics as a Means for Studying the Orientational Mobility of Chromophores and for Creating Macroscopic Order in Amorphous Films	511
Michel Dumont	
A Thermally Stable Organic Light-Emitting Diode	523
P. Di Marco, J. Kalinowski, N. Camaioni, V. Fattori and G. Giro	

BIOMATERIALS

New Conjugate Polymers - A Marriage between Synthetic and Natural Polymers	529
Naoya Ogata	
Solid State Batteries from Chitosan Based Biopolymers	539
A. K. Arof, R. H. Y. Subban and S. Radhakrishna	
Synthesis and Biological Activities of Endo-3,6-Epoxy-1,2,3,6- Tetrahydrophthalimide and Its Polymers	545
Gi Cheol Kim, Jin Gon Jeong, Neung Ju Lee, Chang Sik Ha and Won Jei Cho	
Biotechnological Application of Enzymes from Extremophilic Organisms: Synthesis of Modified Monomers	551
Gianfranco Peluso, Antonio Trincone, Francesco La Cara, Francesco Rosso and Mose Rossi	
Biologic Responses to Polymers and Other Prosthetic Devices	559
Anthony Paul Prezyna	

Bioartificial Polymeric Materials: Natural and Synthetic World Joining in Biomaterials Research	563
Paolo Giusti, Luigi Lazzeri, Maria Grazia Cascone, Niccoletta Barbani and Caterina Cristallini	

RECYCLING OF MATERIALS

Guidelines for the Re-Stabilization of Post-Consumer Recycled Plastics Karen Sun and Laurence Timothy Pearson	571
Recycling of Thermoset Based Composites	583
M. Nasir, C. M. Ruzaidi and A. Halim	
Biodegradable Fibers Made from Truly Biodegradable Thermoplastics	589
Masatsugu Mochizuki and Matsuo Hirami	
'Environmentally Friendly' Fate of Plastic Waste?	597
Mohammed Yasin, Allan J. Amass and Brian J. Tighe	
Chemical Recycling of Waste Plastics: Catalytic Cracking of Heavy Oil from Waste Plastics over Ni-Rey Zeolite	603
Ahmad Rahman Songip, Takao Masuda, Hiroshi Kuwahara and Kenji Hashimoto	

SOL-GEL AND CHEMICALLY PROCESSED MATERIALS

Nanocomposites for Coatings and Optics	611
Helmut K. Schmidt	
Nanocomposites of Grafted Polymers onto Layered Silicate	625
Ahmed Akelah	
CdS Nanoparticles in Gel Film Network: Synthesis, Stability and Optical Properties	645
Arup K. Atta, Prasanta K. Biswas and Dibyendu Ganguli	
Preparation of Dense Thin Films by Sol-Gel with Very High Humidity Sensitivity	653
Gualtiero Gusmano, Angelo Montenero and Enrico Traversa	

MATERIALS FROM NATURAL PRODUCTS

A New Generation of Composite Materials from Agro-Based Fiber	659
Roger M. Rowell	

Advanced Materials from Enzymatic Polymerization of Substituted Phenols in Ordered Templates	667
Madhu S. Ayyagari, Ferdinando F. Bruno, Sukant K. Tripathy, Kenneth A. Marx, David L. Kaplan, Joseph A. Akkara, and D. V. G. L. N. Rao	
Humic Acids Are Versatile Natural Polymers	677
Geoffrey Davies, Elham A. Ghabbour, Susan Jansen and James Varnum	
Palm Oil Based Polyurethane Foams	687
Salmiah Ahmad, Parthiban Siwayanan, Ooi Tian Lye, Rohana Ali, Azman Rafaei, Zuhairi Zainuddin, Dieter Wiese and Chua Meng Choo	
Radiation Vulcanisation Natural Rubber Latex and Its Properties	701
Wan Manshol bin W. Zin	

MULTIFUNCTION AND SMART MATERIALS

Communicating with Responsive Intelligent Membranes	709
A. Mirmohseni, W. E. Price, C. J. Small, C. O. Too, G. G. Wallace and H. Zhao	
Design of Ceramic Materials for Chemical Sensors with Intelligent Properties	719
Enrico Traversa	
The Use of Sol-Gel Film as a Matrix for Entrapment of Fluorimetric Reagents	727
Musa Ahmad and Ramaier Narayanaswamy	
Multifunctional Conjugated Organic Materials Incorporating Stable Charge States	737
Charles W. Spangler and Mingqian He	

BUSINESS OPPORTUNITIES

SABIC and the Saudi Arabian Petrochemical Industry: Anatomy of a Leader	745
Moayyed A. Al-Qurtas	
Polymer Technology and Education Frontiers A Contribution from Australia	753
Alastair N. McKee	

Future of Silicon Science and Technology	759
F. W. Gordon Fearon	
Advanced Materials-Competitiveness by Design	773
Björn Thundal	
Business Opportunities for a New Type of LCP and Its Blends	777
Christer H. Bergström	
Index	785

COMPOSITE APPLICATIONS IN COMMERCIAL TRANSPORT AIRCRAFT

John T. Quinlivan/Henry R. Fenbert

Boeing Commercial Airplanes
Seattle, Washington

ABSTRACT

Since the development of advanced fiber composite materials in the 1950s and 1960s, these materials, particularly carbon fiber/epoxy, have become increasingly important in commercial transport aircraft. These materials and the design/manufacturing technology for their application are now truly global.

To assure continued use of these materials to enhance aircraft performance, their life cycle costs must compete favorably with those of other materials. The two areas driving high composites costs are initial fabrication and repair. The composites industry must continue to demonstrate its commitment to provide value to its customers, the airlines, by aggressive improvements in those areas.

Significant use of advanced composites in commercial aircraft started when several new fibers with impressive structural properties were developed in the late 1950s and early 1960s. Primary among these were boron, graphite and carbon, aramid and S-glass. Resin matrix composites of these materials possess very high specific strength and/or modulus, making them attractive candidates for aircraft applications. By the late 1960s, testing and development had clearly identified carbon filaments as the fibers with the best overall balance of engineering properties, ease of manufacture, and cost. Industry interest in learning to use the materials led to the design, fabrication, and service evaluation of a number of commercial transport airplane components, such as the Boeing 727 elevators, Boeing 737 spoilers, Lockheed L-1011 inboard ailerons, and McDonnell-Douglas DC-10 rudders. Weight reductions averaging 25% were achieved.

New large commercial jet aircraft initiated in the late 1970s – the Boeing 757 and 767, and the Airbus Industries A310 – included the first widespread application of advanced composites to secondary structures. Subsequently, new and derivative models of existing aircraft, such as the MD-11, MD-80, B737, and A300, were introduced with similar composite components.