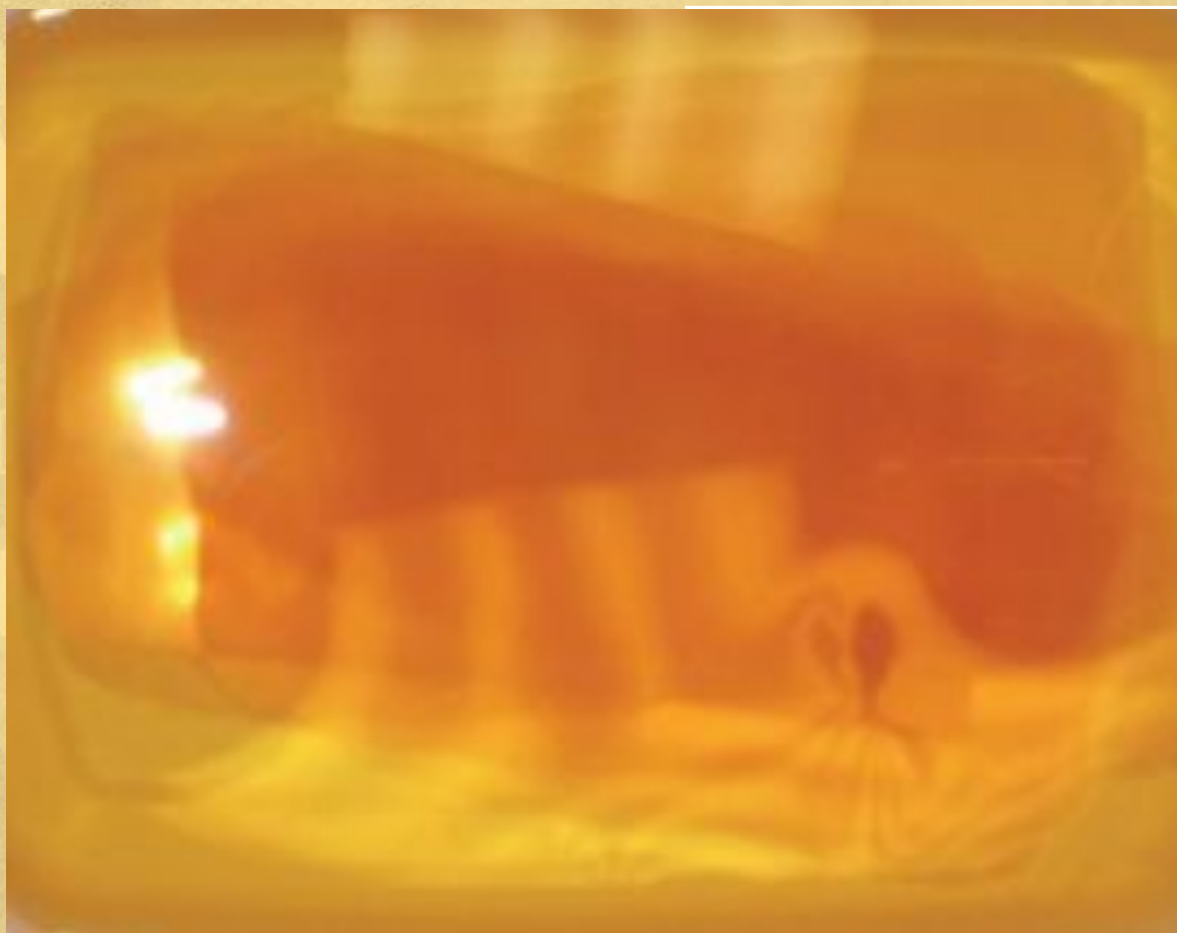


Christopher N. Bowman, Ferenc Horkay (Eds.)

Polymer Gels: Formation, Structure, Properties and Applications



WILEY-VCH

Full text and further information: www.ms-journal.de

Editors (all *Macromolecular Journals*):

Kirsten Severing
Stefan Spiegel

Managing Editor:

Sibylle Meyer

Administration:

Inge Dittmer
Petra Pinto

Production:

Katja Kornmacher

Editorial Office:

macro-symp@wiley-vch.de

Executive Advisory Board:

M. Antonietti, Golm, Germany
C. Barner-Kowollik, Karlsruhe, Germany
D. L. Kaplan, Medford, USA
K. Kiick, Newark, USA
K. Kremer, Mainz, Germany
J.-F. Lutz, Strasbourg, France
H. E. H. Meijer, Eindhoven, Netherlands
R. Mülhaupt, Freiburg, Germany
T. P. Russell, Amherst, USA
A. J. Ryan, Sheffield, UK
J. B. P. Soares, Waterloo, Canada
B. Sumerlin, Gainesville, USA
N. Tirelli, Manchester, UK
B. Voit, Dresden, Germany
C. Wu, Hong Kong, China
B. Z. Tang, Hong Kong, China

Macromolecular Symposia

is published 12 times a year

Annual subscription rate 2013

Europe	Euro	2,529
Switzerland	Sfr	4,003
All other areas	US\$	3,330
		electronic only

All Wiley-VCH prices are exclusive of VAT.

Prices are subject to change.

Online ISSN: 1521 – 3900

Copyright Permission:

Fax: +49 (0) 62 01/6 06-332,

E-mail: rights@wiley-vch.de

Postage and handling charges included. All Wiley-VCH prices are exclusive of VAT. Prices are subject to change.

Contact: www.wileycustomerhelp.com

Cancellation of subscriptions: The publishers must be notified not later than three months before the end of the calendar year.

Order through your bookseller or directly at the publisher:

www.wileycustomerhelp.com

Disclaimer: The Publisher cannot be held responsible for errors or any consequences arising from the use of information contained in this journal; the views and opinions expressed do not necessarily reflect those of the Publisher, neither does the publication of advertisements constitute any endorsement by the Publisher of the products advertised.

Typesetting: Thomson Digital (India) Ltd., India
© 2013 Wiley-VCH Verlag GmbH & Co. KGaA,
Weinheim

Wiley's Corporate Citizenship initiative seeks to address the environmental, social, economic, and ethical challenges faced in our business and which are important to our diverse stakeholder groups. We have made a long-term commitment to standardize and improve our efforts around the world to reduce our carbon footprint. Follow our progress at:
www.wiley.com/go/citizenship

Polymer Gels: Formation, Structure, Properties and Applications

Selected Contributions from:
Polymer Networks 2012 Conference
Jackson Hole, WY, USA
August 12–16, 2012

Symposium Editors:
Christopher N. Bowman
(University of Colorado, Boulder, CO, USA)
Ferenc Horkay
(National Institute of Health (NIH),
Bethesda, MD, USA)

© 2013 WILEY-VCH Verlag GmbH & Co. KGaA
Weinheim

WILEY-VCH

Macromolecular Symposia: Vol. 329

Articles published on the web will appear through:

wileyonlinelibrary.com

Cover: The “Polymer Networks 2012 Conference” (PNG 2012) was held in Jackson Hole, WY, USA, August 12–16, 2012. The cover is selected from the article by Kotek et. al.



Polymer Gels: Formation, Structure, Properties and Applications

Jackson Hole, WY, USA

Preface

Christopher N. Bowman and Ferenc Horkay

Polymer Networks as Biomaterials

Tuning Mechanical Properties of
Chondroitin Sulfate-Based
Double-Network Hydrogels

*Tiffany C. Suekama,
Jian Hu,
Takayuki Kurokawa,
Jian Ping Gong,
Stevin H. Gehrke**

19

Ion Polymer Interactions in DNA Solutions and Gels	<i>Ferenc Horkay</i>	19
Thermoresponsive and Biodegradable Dextran Based Microgels: Synthesis and Structural Investigation	<i>Shivkumar V. Ghugare, Ester Chiessi, Victoria Garcia Sakai, Mark T. F. Telling, Prakash P. Wadgaonkar, Gaio Paradossi*</i>	27
PEG-Based Microgels to Modify Biomaterials Surfaces	<i>Yong Wu, Qichen Wang, Matthew Libera*</i>	35
Inhomogeneity Development During Slow, Irreversible Cross-Linking of Gelatin	<i>Hayfa Souguir, Tristan Baumberger*</i>	41
Combined Electrostatic and Covalent Polymer Networks for Cell Microencapsulation	<i>Redouan Mahou, Gabriela Kolláriková, Carmen Gonelle-Gispert, Raphael Meier, Frederic Schmitt, Nhu Mai Tran, Murielle Dufresne, Ilaria Altimari, Igor Lacík, Léo Bühler, Lucienne Juillerat-Jeanneret, Cécile Legallais, Christine Wandrey*</i>	49
Hydrolytically Degradable Thiol–ene Hydrogels for Protein Release	<i>Matthew S. Rehmman, Andrew C. Garibian, April M. Kloxin*</i>	58
Stimuli-Responsive Polymer Networks with β -Cyclodextrin and Ferrocene Reversible Linkage Based on Linker Chemistry	<i>Huijuan Zhang, Liao Peng, Yan Xin, Qiang Yan, Jinying Yuan*</i>	66
Cellulose and Soy Proteins Based Membrane Networks	<i>Yidan Zhu, Eugene Douglass, Tom Theyson, Robina Hogan, Richard Kotek</i>	70
Polymer Networks Modeling, Synthesis and Characterization		
Influence of Chain Structure and Swelling on the Elasticity of Rubbery Materials: Localization Model Description	<i>Jack F. Douglas</i>	87
Fabrication and Characterization of Novel High Modulus, Two-Stage Reactive Thiol-Acrylate Composite Polymer Systems	<i>Devatha P. Nair, Neil B. Cramer, Mathew K. McBride, John C. Gaipa, Nathan C. Lee, Robin Shandas, Christopher N. Bowman*</i>	101

Synthesis of Model Network Hydrogels via Tetrazine-Olefin Inverse Electron Demand Diels-Alder Cycloaddition	<i>Alexandra M. Cok, Huazing Zhou, Jeremiah A. Johnson</i>	108
Nanogels as a Basis for Network Construction	<i>Eric Dailing, JianCheng Liu, Steven Lewis, Jeffery Stansbury</i>	113
Urea Organogelators – Synthesis and Properties	<i>Natish Bajaj, Lewis R. Hart, Barnaby W. Greenland,* Wayne Hayes</i>	118
Factors Influencing the Shear and Tensile Moduli of Smectic Polydomain Networks	<i>Ziniu Yu, Ronald C. Hedden*</i>	125
Exploring the Effect of Maximum Cure Temperature on the Thermal and Thermomechanical Properties of Polybenzoxazine Networks	<i>Matthew J. Jungman, Jared S. Cobb, Daniel J. Lawler, Jamie D. Sholar, Charles B. Johnson, Derek L. Patton*</i>	133
Polymer Networks in Composite Materials		
Cobalt Replacement in Unsaturated Polyester Resins; Going for Sustainable Composites	<i>Johan F.G.A Jansen,* Iris Hilker, Engelien Kleuskens, Guido Hensen, Ivo Kraeger, Willem Posthumus</i>	142
Stimuli-Responsive Properties of Nanocomposite Gels Comprising (2-methoxyethylacrylate-co- <i>N,N</i> -dimethylacrylamide) Copolymer-Clay Networks	<i>Kazutoshi Haraguchi,* Kazutaka Murata, Toru Takehisa</i>	150
Field-Structured Polymer Composites	<i>James E. Martin</i>	162
Influence of Photopolymerization Characteristics on Thermo-Mechanical Properties of Nanocomposites Utilizing Polymerizable Organoclays in Thiol-acrylate Systems	<i>Soon Ki Kim, Céline Baguenard, C. Allan Guymon*</i>	173
Liquid-Crystalline Epoxy Resins as Matrices in Nanocomposites with Anisotropic Fillers	<i>Beata Mossety-Leszczak,* Magdalena Włodarska, Marcin Kowalik, Krzysztof Łokaj</i>	193

<i>Altimari, I.</i>	49	<i>Lacík, I.</i>	49
<i>Bühler, L.</i>	49	<i>Lawler, D. J.</i>	133
<i>Baguenard, C.</i>	173	<i>Lee, N. C.</i>	101
<i>Bajaj, N.</i>	118	<i>Legallais, Cécile</i>	49
<i>Baumberger, T.</i>	41	<i>Lewis, S.</i>	113
<i>Bowman, C. N.</i>	101	<i>Libera, M.</i>	35
<i>Chiessi, E.</i>	27	<i>Liu, J.</i>	113
<i>Cobb, J. S.</i>	133	<i>Łokaj, K.</i>	193
<i>Cok, A. M.</i>	108	<i>Mahou, R.</i>	49
<i>Cramer, N. B.</i>	101	<i>Martin, J. E.</i>	162
<i>Dailing, E.</i>	113	<i>McBride, M. K.</i>	101
<i>Douglas, J. F.</i>	87	<i>Meier, R.</i>	49
<i>Douglass, E.</i>	70	<i>Mossety-Leszczak, B.</i>	193
<i>Dufresne, M.</i>	49	<i>Murata, K.</i>	150
<i>Gaipa, J. C.</i>	101	<i>Nair, D. P.</i>	101
<i>Garibian, A. C.</i>	58	<i>Paradossi, G.</i>	27
<i>Gehrke, S. H.</i>	9	<i>Patton, D. L.</i>	133
<i>Ghugare, S. V.</i>	27	<i>Peng, L.</i>	66
<i>Gonelle-Gispert, C.</i>	49	<i>Posthumus, W.</i>	142
<i>Gong, J. P.</i>	9	<i>Rehmann, M. S.</i>	58
<i>Greenland, B. W.</i>	118	<i>Sakai, V. G.</i>	27
<i>Guymon, C. A.</i>	173	<i>Schmitt, F.</i>	49
<i>Haraguchi, K.</i>	150	<i>Shandas, R.</i>	101
<i>Hart, L. R.</i>	118	<i>Sholar, J. D.</i>	133
<i>Hayes, W.</i>	118	<i>Souguir, H.</i>	41
<i>Hedden, R. C.</i>	125	<i>Stansbury, J.</i>	113
<i>Hensen, G.</i>	142	<i>Suekama, T. C.</i>	9
<i>Hilker, I.</i>	142	<i>Takehisa, T.</i>	150
<i>Hogan, R.</i>	70	<i>Telling, M. T. F.</i>	27
<i>Horkay, F.</i>	19	<i>Theyson, T.</i>	70
<i>Hu, J.</i>	9	<i>Tran, N. M.</i>	49
<i>Jansen, J. FGA</i>	142	<i>Włodarska, M.</i>	193
<i>Johnson, C. B.</i>	133	<i>Wadgaonkar, P. P.</i>	27
<i>Johnson, J. A.</i>	108	<i>Wandrey, C.</i>	49
<i>Juillerat-Jeanneret, L.</i>	49	<i>Wang, Q.</i>	35
<i>Jungman, M. J.</i>	133	<i>Wu, Y.</i>	35
<i>Kim, S. K.</i>	173	<i>Xin, Y.</i>	66
<i>Kleuskens, E.</i>	142	<i>Yan, Q.</i>	66
<i>Kloxin, A. M.</i>	58	<i>Yu, Z.</i>	125
<i>Kolláriková, G.</i>	49	<i>Yuan, J.</i>	66
<i>Kotek, R.</i>	70	<i>Zhang, H.</i>	66
<i>Kowalik, M.</i>	193	<i>Zhou, H.</i>	108
<i>Kraeger, I.</i>	142	<i>Zhu, Y.</i>	70
<i>Kurokawa, T.</i>	9		

This volume contains selected presentations from the Polymer Networks 2012 Conference (21st Polymer Networks Group Meeting) held in Jackson Hole, WY, from August 12-16, 2012. The meeting was attended by nearly 200 participants from academia, industry and national laboratories, representing more than 20 countries and fields ranging from fundamental polymer network synthesis and design to practical implementation as composites in numerous applications.

Polymer science is by nature an interdisciplinary field, traditionally spanning chemistry, physics and engineering. One of the most promising new developments in polymer science is the interaction with other disciplines such as biology and medicine. The goal of the Polymer Networks 2012 Conference was to provide an interdisciplinary forum for chemists, physicists, materials scientists and engineers to meet and discuss their work, exchange ideas, and assess the latest developments in the rapidly expanding field of polymer gels and networks. The most recent advances from the following topical categories were discussed: Biomaterials, Composite Materials, Network Synthesis, Structure and Mechanical Properties, Nanogels & Patterned Networks.

Christopher N. Bowman
Chair of the Polymer Networks 2012 Conference
University of Colorado
Boulder, CO

The conference focused on all areas relevant to the formation, structure, analysis and applications of synthetic and natural polymer networks and gels, including materials science, nanotechnology, surface science, rheology, tissue engineering, and modeling. In particular, the conference explored experimental tools and theoretical models to describe biological phenomena with physical concepts that allow predictive, model-driven research. This knowledge is essential for understanding, designing, and controlling material properties and performance. The collection of papers in this volume is representative and illustrates that increased understanding of the behavior of complex gel systems is critical to developments in biomedical research, biotechnology and medicine.

We thank the authors of the papers for their invaluable contributions to this exciting volume. We also acknowledge the colleagues who reviewed the manuscripts, as well as the staff of the Macromolecular Symposia. We would like to express our gratitude to the members of the Advisory Board and the Organizing Committee of the Polymer Networks 2012 Conference for their excellent work before and during the conference.

Ferenc Horkay
Chair of the Polymer Networks Group
NICHD, National Institutes of Health
Bethesda, MD