

IUPAC MACROMOLECULAR DIVISION (IV)

Report to Bureau for 2003 - 2004

Structure of Report

Section I highlights and summarises key points in terms of achievements and developments. **Section II** describes Division IV's activities according to the goals of the IUPAC Strategic Plan.

Section III lists collected data detailing the projects, conferences and publications with which Division IV has been involved.

I. Highlights and Executive Summary

- .. Associate and Titular Members have defined, co-ordinating roles to play. Their areas of activity continue essentially as for the preceding biennial review to Council.
- .. Two more areas of activity, namely, the Structure - Property Characterization of Commercial Polymers and the Modelling of Polymerization Kinetics and Processes, are now structured as **Sub-Committees**.
- .. The **areas of activity** of the Division and the associated co-ordinators are:

Sub-Committee on the Structure - Property Characterization of Commercial Polymers
(Co-ordinators R.S. Bailey (AM), S.C. Kim (TM))

Molecular Characterization of Polymers (Co-ordinator H. Pasch (AM))

Sub-Committee on the Modelling of Polymerization Kinetics and Processes (Co-ordinator M. Buback (TM))

Sub-Committee on Macromolecular Terminology (Co-ordinators M. Hess (AM) (Chairman), R.G. Jones (TM) (Secretary))

Developing Polymer Materials Systems (Co-ordinators C. Ober (TM), J. Vohlřdal (AM), W.J. Work (TM))

Education (Co-ordinators J.-Il Jin (TM), R.D. Sanderson (TM), J.-P. Vairon (AM))

Conference Sponsorship and Recruitment at Conferences
(Co-ordinators P. Kubisa (TM), S. Penczek (AM))

Electronic Publications and Communications
(Co-ordinators R.G. Jones (TM), W.J. Work (TM))

Division Strategy (Co-ordinators K. Horie (TM), J.-Il Jin (TM))

- .. The Division continues pursue a policy of having all its reports and recommendations available on the **Division web site**.

- .. The Division's work on the **Structure - Property Characterization of Commercial Polymers** continues to make a significant input in this vital industrial and academic area. It represents an enormous effort and a sizeable industrial investment in terms of facilities and manpower. The work involves 69 active task group members from 17 countries, with 31 members from industry and 38 from academia. The Division sees the work as a flagship activity. 4 papers have been published in the last year (publications [14,16,21,22]). There are 6 current projects and 19 projects under feasibility study. Activities are now organised by the **Sub-Committee on the Structure - Property Characterization of Commercial Polymers** and Rob Bailey and Sung Chul Kim, the Co-Chairmen of the Sub-Committee, co-ordinate the projects. Since the GA in Ottawa, there have been 4 S-C meetings, 2 in Europe and 2 in East Asia.

- .. The projects under the **Molecular Characterization of Polymers** involve about 36 task group members. The work is presently based on evaluating and developing size-exclusion chromatography methods and the Division will be seeking to broaden the investigations to include other methods.
The co-ordination of projects in this area is now under Harald Pasch. During the last year, 1 project has been completed, resulting, so far, in 2 conference publications (publications [29,30]), and 1 new project has been started. There is also a terminology project associated with molecular characterization that is run by the Sub-Committee on Macromolecular Terminology and is joint with Division V.

- .. The projects in the area of polymerization are now run by the **Sub-Committee on the Modelling of Polymerization Kinetics and Processes**. The work is related to polymerizations of industrial relevance. The Chairman of the S-C and the person co-ordinating the projects is Michael Buback. The S-C has 23 members from 11 countries, with 2 members from industry. It has had 1 meeting since Ottawa. There are 3 current projects and 3 feasibility studies under consideration. In 2003-4, there has been 1 publication and 2 publications are in press (publications [31-33]). Publications continue to receive very high numbers of citations.

- .. The **Sub-Committee on Macromolecular Terminology** has Michael Hess as Chairman and Dick Jones as Secretary. The Subcommittee has 29 members and about 25 additional, active task-group members. The S-C collaborates actively with Division VIII on macromolecular nomenclature projects, with the Chairman of the S-C being a TM of Division VIII.
2 projects have been completed since Ottawa, with 1 publication and 1 paper in press (publications [34,35]). The S-C has 8 current projects with 6 nearing completion. Importantly, it also has 7 joint projects, 1 with Division II, 1 with Division V, and 5 with Division VIII. There are also 11 feasibility studies, including a new initiative on bio-related projects. 1 meeting of the S-C has been held since Ottawa.

- .. The area of activity **Developing Polymer Materials Systems** is co-ordinated by Chris Ober, Jiri Vohlidal and Bill Work. The intention is to keep the projects and activities of Division IV at the forefront of scientific and technological developments in polymer science and technology. Thus far, there have been two dedicated projects on conducting polymers under Jara Stejskal (Institute of Macromolecular Chemistry, Prague). The

second project has just been completed and a Technical Report is in press (publication [36]).

Notably, in the last year or so, efforts in developing polymer materials systems have led to new feasibility studies in biopolymers (characterization and terminology), field-responsive polymers (terminology), conducting polymers (characterization), and self-assembly and aggregation (terminology). Some of these feasibility studies will generate projects in other areas of Division IV's activities.

- .. The Division continues to see **Education** (in Polymer Science), particularly of young people and for those from educationally hindered countries, as an important activity. About 15 active task-group members are involved and the work is co-ordinated by Jung-Il Jin, Ron Sanderson and Jean-Pierre Vairon.
During the last year, the Division will have partially sponsored and supported 1 educational course (Prague) (leading, for example, to publications [37-40]) and 1 workshop (Guimaraes, Portugal). In addition, increased co-operation with CCE has led to a significant participation of polymer scientists in the 18th Conference on Chemical Education in Istanbul in 2004.
- .. The Division is grateful to the **Project Committee** for supporting its 2 applications for financial support for UNESCO/IUPAC conferences in South Africa (2004) and Mauritius (2005), related particularly to the IUPAC programme for developing countries. These conferences originated through Division IV's initiatives in education. (See list of Sponsored Conferences in Section III.)
- .. Linked with its work in **Education**, the first awards from the interest on the endowment from the **Samsung General Chemicals Company of South Korea**, were made in 2004. An **IUPAC-Samsung Young-Scientist Award** was presented at the IUPAC World Polymer Congress in Paris and **Bursaries** were given to help 12 students attend the Congress.
- .. A successful **Symposium on Polymer Education** was held as part of the 2004 IUPAC World Polymer Congress in Paris. This was a new venture that the Division hopes to continue at future WPCs.
- .. At the IUPAC-sponsored Polymer Networks 2004 Meeting, in Bethesda, USA, the first **IUPAC Poster Prizes** were awarded for posters from young scientists.
- .. As with Education, the Division continues to place particular emphasis on **Conference Sponsorship**. Largely through the efforts of the Co-ordinators for Conference Sponsorship, Przemyslaw Kubisa and Stan Penczek, and other Division Members, a total of **20 IUPAC-sponsored polymer conferences** have been and will be held in 2003 and 2004, maintaining the high level of conference sponsorship from the previous biennium. **Nine conference volumes** have been published in 2003. See publications [1-9]. (Data for 2004 are still awaited.) More than half of the issues of Macromolecular Symposia are devoted to IUPAC-sponsored conferences, representing a significant income to IUPAC.
- .. The IUPAC World Polymer Congress of 2004, organised through the Division, was held in Paris. It is generally recognised that the biennial IUPAC World Polymer Congress, is the main event in the international polymer conference calendar. This year's Congress, with about 2500 participants, was the largest ever.

The WPC in 2006 will be held in Rio de Janeiro and that in 2008 will be held in Taipei.

- “ Regarding **Recruitment at Conferences**, the Division Brochure is distributed at all IUPAC-sponsored conferences. In addition, the Powerpoint presentations issued by the Secretariat have been augmented to emphasise Macromolecular Division activities. Electronic versions of the brochure and the presentations are given to all conference organisers and IUPAC representatives.
- “ The consideration of **Polymer World and Division Strategies**, started during the last biennium, has continued. Polymer Science and Technology is no longer based primarily on the macromolecule but it is central to many modern functional and structural materials. The Division’s aims and activities need to change continually and to grow in order to reflect the new emphasis and increasing diversity. The work is co-ordinated by Kazuyuki Horie and Jung-Il Jin.
1 publication on the **Mission and Challenges of Polymer Science and Technology** [10] has resulted from the successful **Strategic Polymer Conference** in Kyoto in December 2002. A second strategic conference is planned for New York in 2007.
- “ Division IV has a **strategic project** on future developments in polymer science. Work on the project helps to prepare, together with the Society of Polymer Science, Japan, a continually up-dated booklet giving details of all World Polymer Organisations and their activities.
During the 2004 World Polymer Congress, a **symposium on international collaboration in polymer science and technology** was held for the first time as part of a WPC. The symposium involved representatives from the polymer organisations of many countries and world regions and subsumed the biennial Polymer Summit Meeting in its proceedings. The Division hopes to maintain this type of symposium at future WPCs.
- “ **Future Plans and Structure**
 - “ The Division intends to maintain its existing project areas, Structure-Property Characterization, Molecular Characterization, Polymerization Modelling, Terminology and Nomenclature, Developing Polymer Materials Systems and Education and also its efforts in Conference Sponsorship.
 - “ It will seek to expand its profiles in Molecular Characterization and Developing Polymer Materials Systems and maintain its high level of activity and throughput in all project areas and in Conference Sponsorship.
 - “ The Division will seek to play a strategic role in defining the important areas of world polymer research through its strategic study and conferences.
 - “ At the Division IV Committee Meeting in Paris in July, 2004, the Division voted to change its name to Polymer Division in order to reflect that its activities now cover polymers as substances and materials as well as macromolecules. The Secretariat has been contacted to initiate the process required for the change of name.
 - “ In order to give continuity to the Division’s structure and range of activities, the elections to the Division Committee in 2005 will be to positions designated for particular responsibilities, essentially those listed at the beginning of this report.

II. Division Activities and the IUPAC Strategic Plan

(a) World Leadership

The Division has a **Strategic Study** into the needs and direction of World Polymer Science (project 2002-057-1-400) and it helped to organise the first **Strategic Conference**, in Kyoto, December 2002, on the Mission and Challenges of Polymer Science and Technology. A keynote article of the same title as the conference has been published in Pure and Applied Chemistry (publication [10]). A second strategic conference is planned for June 2007 in New York.

The **IUPAC World Polymer Congresses** organised biennially under the auspices of Division IV are the largest and the most important conferences in the international polymer conference calendar. The WPC in 2004 took place in Paris, that in 2006 will take place in Rio de Janeiro and in 2008 the WPC will be in Taipei.

(b) Advancement of Research through International Standardisation and Scientific Discussion

The Division is active in several areas under this heading, as witnessed by the work of the Sub-Committees on the Structure - Property Characterization of Commercial Polymers, the Modelling of Polymerization Kinetics and Processes, and Macromolecular Terminology, as well as its work on the Molecular Characterization of Polymers and on Developing Polymer Materials Systems. Overall, 10 projects have been completed, 7 new projects have been launched and 21 other projects have been active during 2003-2004. 31 reports and papers have been published or are in press (publications [10-40]). In addition, a total of 6 meetings has been held by the three Sub-Committees.

(c) Assistance to Chemistry-Related Industry

The Division's work in the four areas of Structure - Property Characterization of Commercial Polymers, Molecular Characterization of Polymers, Polymerization Kinetics Characterisation and Developing Polymer Materials Systems is directly related to the needs of chemistry-related industry. Of the detailed figures given under (b), this work accounts for 3 of the new projects, 7 of the active projects, 29 of the publications and 5 of the meetings of the Sub-Committees.

(d) Fostering Communication between Individual Chemists and Scientific Organisations

The **strategic study and strategic conferences** described under (a) are definite attempts to foster communication between individual chemists and scientific organisations.

The **Symposium on International Collaboration**, organised in conjunction with the latest World Polymer Congresses brought together representatives from Chemical and Polymer Societies from across the world and fostered scientific discussion and the exchange of ideas. A booklet giving details of all World Polymer Organisations was prepared for the symposium by the Society of Polymer Science, Japan under the auspices of Division IV.

The **20 conferences sponsored** in 2003-2004 and the **9 volumes of conference papers** published so far [1-9] in the same period represent attempts to foster communication between individual chemists.

The **4 educational courses, workshops and conferences** partially sponsored and supported by the Division and IUPAC (Project Committee) have been and will be aimed specifically at young chemical scientists from educationally hindered countries.

(e) Enhancement of Chemistry Education, Development of Young Scientists and Public Appreciation of Chemistry

As just stated under (d), the 4 educational courses, workshops and conferences partially sponsored and supported by the Division and IUPAC (Project Committee) were aimed at young chemical scientists from educationally hindered countries. They account for 2 of the 7 new projects in the period 2003-4.

Students on one of the courses, the postgraduate course based in Prague, have published numerous papers in journals (for example, publications [37-40]). The other workshops and conferences have led and will lead to material being issued as booklets and in electronic format, some of which will appear on the Division web site.

A Young-Scientist Award and Student Bursaries were presented at the 2004 World Polymer Congress and IUPAC Poster Prizes were presented at Polymer Networks 2004.

(f) Breadth of National Membership

Scientists involved with Division IV are spread worldwide. For example, the Division Committee, numbering 26, has members from 18 countries, the Subcommittees on Macromolecular Terminology, Structure - Property Characterization of Commercial Polymers, and Modelling Polymerization Kinetics and Processes have members from 15, 17 and 11 countries, respectively.

R.F.T. Stepto
Manchester
22nd September, 2004

III. Collected Data

Projects

Structure –Property Characterization of Commercial Polymers

Completed Projects

421/20/87 Characterisation of flow behaviour and properties of Liquid Crystal and Aromatic Polymers

Task Group Leader: J.L.S. White

421/31/93

Structure and Properties of Hydrogenated NBR

Task Group Leaders: T. Kobatake and T. Masuda

421/33/95

Rheological and Mechanical Properties of P α MSAN/PMMA Blends in Miscible and Phase Separated Regimes of Various Morphologies

Task Group Leaders: H.M. Laun, L. Lyngaae-Jørgensen and V. Altstädt

421/34/95

Property Improvement via Interfacial Chemical Reaction - Reactive Extrusion of EVOH/SMA and Polyamide/MAH-EPR

Task Group Leaders: J.E. Curry, J.G. Bonner, and P.S. Hope

421/35/97

Effects of Side-Chain Branching on Processability of Commercial Polycarbonates

Task Group Leaders: M. Takahashi, K. Sato, T. Masuda

Continuing Projects

1999-020-1-400

Quantifying scratch resistance of commercial polymers

Task Group Leader: R.S. Bailey

1999-039-1-400

Structure and Properties of Cyclic Olefin Copolymers

Task Group Leader: S.C. Kim

2002-052-1-400

Structure and Properties of polyester elastomers composed of poly(butylenes terephthalate) and poly(ϵ -caprolactone)

Task Group Leader: T. Takigawa

2003-009-1-400

Recommendations for data presentation, applicable to mechanical and rheological measurements of polymers.

Task Group Leader: E. Wassner

New Projects

2003-051-1-400

Structure and Properties of polymer/clay nano-composite materials.

Task Group Leader: S. C. Kim

Project 2004-009-1-400

Guideline for rheological characterisation of polyamide melts.

Task Group Leader: D. Dijkstra

Molecular Characterization of Polymers

Completed Project

1999-021-1-400

Round-Robin Test on the Molecular Characterization of Epoxy Resins by Liquid Chromatography

Task Group Leader: S. Podzimek

New Project

2003-023-2-400

Data treatment in size exclusion chromatography of polymers

Task Group Leader: G. R. Meira

Modelling of Polymerization Kinetics and Processes

Continuing Projects

2000-028-1-400

Critically Evaluated termination Rate Coefficients for Free-Radical Polymerization

Task Group Leader: G.T. Russell

2002-023-1-400

Critically Evaluated Propagation Rate Coefficients for Free-Radical Polymerizations: Acrylic Acid Alkyl Esters

Task Group Leader: R. Hutchinson

2002-053-1-400

Establishment of Quantitative Reliability of Electron Spin Resonance Techniques for Polymerization Kinetics

Task group Leader: B. Yamada

Macromolecular Terminology and Nomenclature

Completed Projects

410/24/93

Terminology Related to Polymer Composites and Blends

Task Group Leaders: K. Horie, W.J. Work

1999-048-1-400

Definition of Terms Relating to Reactions of Polymers and Functional Polymers

Task Group Leader: K. Horie

Continuing Projects

410/22/93

Guide to Polymer Terminology and Macromolecular Nomenclature

Task Group Leader: E.S. Wilks

2000-006-1-400/2004-008-1-400

Terminology of Polymers Containing Ionizable Groups and Polymers Containing Ions

Task Group Leader: P. Kubisa

2000-014-1-400

Glossary of Class Names of Polymers Based on their Chemical Structure and Molecular Architecture

Task Group Leader: J. Vohlidal

2000-016-1-400

Terminology for the Kinetics, Thermodynamics and Mechanisms of Polymerizations

Task Group Leader: S. Penczek

2000-017-1-400

Polymerization Processes and Polymers in Dispersed Systems

Task Group Leader: S. Slomkowski

2002-006-2-400

Terminology for Radical Polymerizations with Minimal Termination – the so-called “Living” and “Controlled” Radical Polymerizations

Task Group Leaders: A.D. Jenkins, R.G. Gilbert, G. Moad

2002-048-1-400

Purple Book, 2nd Edition

Task Group Leader: E.S. Wilks

2003-021-1-400

Definitions of Terms Relating to Crystalline Polymers

Task Group Leader: G. Allegra

Continuing Interdivisional Projects

IV/II

2000-007-1-400

Glossary of Terms Relating to Polymeric Gels and Networks, Hybrid Inorganic Polymer Materials and the Processing thereof

Task Group Leaders: R.G. Jones, M. Hess

VIII/IV

1999-051-1-800

Source Based Nomenclature for Modified polymer Molecules

Task Group Leader: T. Kitayama

2000-037-1-800

Nomenclature for Macromolecular Rotaxanes

Task Group Leader: A. Yerin

2000-081-1-800

Terminology and Structure-Based Nomenclature of Dendritic and Hyperbranched Polymers

Task Group Leader: J. Kahovec

2000-082-1-800

Terminology and Nomenclature of Macromolecules with Cyclic Structures

Task Group Leader: W. Mormann

New Interdivisional Projects

IV/V

2003-060-2-400

Terminology for the Chromatographic Separation of Molecules

Task Group Leader: T. Chang

VIII/IV

2003-042-1-800

Source-Based nomenclature of Single-Strand Organic Polymers

Task group Leader: T. Kitayama

Developing Polymer Materials Systems

Completed Project

2002-019-1-400

Conducting Polymer Colloids and Nanofilms

Task Group Leader: J. Stejskal

Education

Completed Project

2002-047-1-400

UNESCO/IUPAC Postgraduate Course in Polymer Science

Task Group Leader: P. Kratochvíl

New Projects

2003-041-1-400

UNESCO/IUPAC Postgraduate Course in Polymer Science

Task Group Leader: P. Kratochvíl

2003-021-2-400

12th Annual Course on Polymer Characterization

Task Group Leader: A. Cunha

Strategy

Continuing Project

2002-057-1-400

Strategic Study of World Polymer Science

Task Group Leader: M. Sawamoto

Conference Sponsorship

2003

11th International Conference on Polymer Characterization (POLYCHAR-11), Denton, Texas, USA, January 6-10, 2003

6th Annual UNESCO School/IUPAC Conference on Polymer Properties, Mpumalanga, South Africa, April 14-17, 2003

Xth International Symposium on Macromolecule Metal Complexes (MMC-X), Moscow, Russia, May 20-24, 2003

International Symposium on Ionic Polymerization, Boston, USA, June 30 - July 4, 2003

Degradation, Stabilization, and Recycling of Polymers, Prague, Czech Republic, July 14-17, 2003

Spectroscopy of Partially Ordered Macromolecular Systems, Prague, Czech Republic, July 21-24, 2003

17th Bratislava International Conference on Macromolecules. Molecular Characterization of Polymers, Bratislava, Slovakia, August 24-28, 2003

Interfaces and Interphases in Multicomponent Materials, Balatonfüred, Hungary, Oct 5-8, 2003

1st International Conference on Bio-based Polymers (ICBP 2003), Saitama, Japan, Nov 12-14, 2003

8th Pacific Polymer Conference, Bangkok, Thailand, Nov 24-27, 2003

2004

12th Annual Polychar World Forum on Advanced Materials, Guimaraes, Portugal, Jan. 5-9, 2004

7th Annual UNESCO School/IUPAC Conference on Polymer Properties, Stellenbosch, South Africa, April 5-8, 2004

8th World Conference on Biodegradable Polymers and Plastics, Seoul, Korea, June 1-4, 2004

World Polymer Congress 2004 - 40th IUPAC 40th Int. Symposium on Macromolecules, Paris, France, July 4-9, 2004

43rd PMM Microsymposium: Polymer Biomaterials; Biomimetic and Bioanalogous Systems, Prague, Czech Republic, July 12-15, 2004

11th International Conference on Polymers and Organic Chemistry, Prague, Czech Republic, July 18-23, 2004

18th International Conference on Chemical Education, Istanbul, Turkey, August 3-8, 2004

Polymer Networks 2004, Bethesda, MD, USA, August 15-19, 2004

Biological Polyesters (ISBP2004), Beijing, China, August 22-28, 2004

5th International Symposium on Natural Polymers and Composites, Sao Pedro, Brazil, September 12-15, 2004

2005

8th Annual UNESCO School & IUPAC Conference on Macromolecules, Reduit, Mauritius, June 4-9, 2005

23rd Discussion Conference PMM, Current trends in Polymeric, Czech Republic, June 26-30, 2005

67th Prague Meeting on Macromolecules: "Polymer Gels and Networks", Prague, Czech Republic, July 10-14, 2005

11th International Symposium on Macromolecule-Metal Complexes, Tirrenia, Italy, September 18-22, 2005

2006

World Polymer Congress MACRO 2006, 41st IUPAC International Symposium on Macromolecules, Rio de Janeiro, Brazil, July, 2006

2007

Polymer Conference on the Mission & Challenges of Polymer Science and Technology II, New York, June, 2007

2008

World Polymer Congress MACRO 2008, 42nd IUPAC International Symposium on Macromolecules, China/Taipei, 2008

Publications

Conference Publications

1. 10th International Symposium on Macromolecule-Metal Complexes
Moscow, Russia, May 20-24
ed. T. M. Birshstein
Macromol. Symp. **191**, 1-200 (2003)
2. 5th Annual School and IUPAC Conference on Macromolecules and Material Science,
Stellenbosch, South Africa, March 2002
eds. H. Pasch, R. D. Sanderson
Macromol. Symp. **193**, 1-304 (2003)
3. 39th International Conference on Macromolecules-IUPAC World Polymer Congress
(MACRO 2002), Beijing, China, July 2002
ed. M. Xu
Macromol. Symp. **195**, 1-327 (2003)
4. Metal and Metalloid Containing Macromolecules, Ottawa, Canada, August 10-15, 2003
ed. A.S. Abd-El-Aziz
Macromol. Symp. **196**, 1-353 (2003)
5. 7th World Conference on Biodegradable Polymers and Plastics, Tirenna, Pisa, Italy, June 4-8, 2002
eds. E. Chellini, R. Solaro
Macromol. Symp. **197**, 1-466 (2003)
6. 16th Polymer Network Group Meeting, Polymer Networks 2002, Autrans, France, 2-6 Sept. 2002
ed. E. Geisler
Macromol. Symp. **200**, 1-296 (2003)
7. Mission and Challenges of Polymer Science and Technology, Kyoyo, Japan, 2-5 Dec. 2002, *eds. K. Horie, A. Abe*
Macromol. Symp. **201**, 1-325 (2003)
8. Polymer-Solvent Complexes and Intercalates, 63rd Prague Macromolecular Meeting,
Prague, Czech Republic, July 21-25, 2002
eds. J. Spevacek, J. Kahovec
Macromol. Symp. **203**, 1-338 (2003)
9. 10th International Symposium on Macromolecule-Metal Complexes, Moscow, Russia,
May 18-23, 2003
eds. E. Karakhanov, A. Maksimov
Macromol. Symp. **204**, 1-294 (2003)

Strategy

10. The Missions and Challenges of Polymer Science and Technology

R.F.T. Stepto, K. Horie, T. Kitayama and A. Abe

Pure and Applied Chemistry **75**, 1359-69 (2003)

Structure –Property Characterization of Commercial Polymers

11. Characterisation of Flow Behaviour and Properties of Liquid Crystal and Aromatic Polymers

J. L. S. White, L. Dong, P. Han and H.M. Laun

Pure and Applied Chemistry, *submitted 2004*

(Project 421/20/87)

12. Structure and Properties of Hydrogenated Acrylonitrile-Butadiene Rubber (HNBR). Part I. Relation between Viscosity and Intermolecular Interaction in Dilute Solution States

T. Kobatake, A. Yoshioka, K. Nakayama, J. He, Y. Aoki, T. Masuda

Pure and Applied Chemistry, *manuscript prepared 2002*

(Project 421/31/93)

13. Structure and Properties of Hydrogenated Acrylonitrile-Butadiene Rubber (HNBR). Part II. Relation between Viscosity and Intermolecular Interaction in Condensed States

T. Kobatake, A. Yoshioka, K. Nakayama, J. He, Y. Aoki, T. Masuda

Pure and Applied Chemistry, *manuscript prepared 2002*

(Project 421/31/93)

14. Rheological and mechanical properties of poly(α -methylstyrene-co-acrylonitrile)/poly(methylmethacrylate) blends in miscible and phase separated regimes of various morphologies. Part 4. Influence of the morphology on the mechanical properties

V. Altstädt, L. de Lucca Freitas & D. W. Schubert

Pure and Applied Chemistry **76**, 389-413 (2004)

(Project 421/33/95)

15. Property improvement via interfacial chemical reaction - Reactive extrusion of polyamide 12 and maleic anhydride grafted ethylene propylene copolymer rubber

J. E. Curry, P. S. Hope and J. G. Bonner

Pure and Applied Chemistry 2004, *in press*

(Project 421/34/95)

16. Influence of long chain branching on linear viscoelastic flow properties and dielectric relaxation of polycarbonates

C. Liu, C. Li, P. Chen, J. He and Q. Fan

Polymer **45**, 2803-2812 (2004)

(Project 421/35/97)

17. Characterisation and rheological properties of three polycarbonates with side-chain branching
M. Takahashi, K. Sato, P. Tas, J. He, M. Lecomte and T. Masuda
Pure and Applied Chemistry, *manuscript prepared 2002*
(Project 421/35/97)
18. Processability and mechanical properties of three polycarbonates with side-chain branching
M. Takahashi, K. Sakai, K. Sato, J. He, P. Tas and T. Masuda
Pure and Applied Chemistry, *manuscript prepared 2002*
(Project 421/35/97)
19. Measuring the abrasion resistance of commercial polymers and coatings
R. Bailey, J. Puskas, A. Lauterbach and A. McNicol
Pure and Applied Chemistry, *manuscript prepared 2004*
(Project 1999-020-1-400)
20. Single asperity scratching measurements of commercial polymers and coatings
R. Bailey, A. McNicol, P. Lamber and, H. Steininger
Pure and Applied Chemistry, *manuscript prepared 2004*
(Project 1999-020-1-400)
21. Chemical Structure and Physical Properties of Cyclic Olefin Copolymers
J. Y. Shin, J. Y. Park, C. Liu, J. He and S. C. Kim
Pure and Applied Chemistry **76**, 389-414 (2004)
(Project 1999-039-1-400)
22. Thermal Degradation Studies on Cyclic Olefin Copolymers
C. Liu, J. Yu, X. Sun, J. Zhang and J. He
J. Polymer Degradation and Stability **81**, 187-205 (2003)
(Project 1999-039-1-400)
23. Dependence of zero-shear viscosity and steady state compliance on molecular weight between entanglements for ethylene-cycloolefin copolymers
T. Takigawa, H. Kadoya, T. Miki, T. Yamamoto and T. Masuda
Rheologica Acta, *submitted 2004*
(Project 1999-039-1-400)
24. Rheological properties of Cyclic Olefin Copolymers
T. Takigawa, D. Dijkstra and J. He
Pure and Applied Chemistry, *manuscript prepared 2004*
(Project 1999-039-1-400)
25. Mechanical and Dynamic Mechanical Properties of Cyclic Olefin Copolymers
K. Nitta, K. Nakayama and G. Michler
Pure and Applied Chemistry, *manuscript prepared 2004*
(Project 1999-039-1-400)

26. Impact Strength and Optical Properties of Cyclic Olefin Copolymer and Styrenic Block Copolymer Blends

S. C. Kim

Pure and Applied Chemistry, *manuscript prepared 2004*

(Project 1999-039-1-400)

27. Dynamic Birefringence of COC

T. Inoue

Pure and Applied Chemistry, *manuscript prepared 2004*

(Project 1999-039-1-400)

Molecular Characterization of Polymers

28. Characterization of Polyamides 6, 11 and 12; Determination of Molecular Weight by Size Exclusion Chromatography

E.C. Robert, R. Bruessau, J. Dubois, B. Jacques, N. Meijerink, T.Q. Nguyen, D.E.

Niehaus and W.A. Tobisch

Pure and Applied Chemistry, *in press*

(Project 422/6/98)

29. Molecular Characterization of Epoxy Resins by Liquid Chromatography

S. Podzimek et al.

Proc. 16th International Bratislava Meeting on Polymers, Bratislava, Slovakia, 2001

(Project 1999-021-1-400)

30. Molecular Characterization of Epoxy Resins by Liquid Chromatography

S. Podzimek et al.

Proc. 17th International Symposium on Polymer Analysis and Characterization (ISPAC), Heidelberg, Germany, 2004

(Project 1999-021-1-400)

Modelling of Polymerization Kinetics and Processes

31. Critically Evaluated Rate Coefficients for Free-Radical Polymerization 4: Propagation Rate Coefficients for Methacrylates with Cyclic Ester Groups

S. Beuermann, M. Buback, T.P. Davis, N. García, R.G. Gilbert, R.A. Hutchinson, A.

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