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Macromolecules in the 21st Century: An International Symposium on Polymer Science and Technology on the occasion Otto Vogl's 75th Birthday

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Conference Report

Macromolecules in the 21st Century:



An International Symposium on Polymer Science and Technology

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An International Symposium on Polymer Science and Technology entitled *Macromolecules in the 21st Century* was held in Vienna, Austria, from October 7-9, 2002. This is the first conference of this kind in Central Europe. It was held under the auspice of the Oesterreichischer Gewerbeverein (Austrian Trade Association) (ÖGV) and the Gesellschaft der Chemiewirtschaft (Society of the Chemical Industry, Austria) (GfC).

The symposium was organized by an Organizing Committee that consisted of Josef Schurz, University of Graz, Graz, Austria (Chairman); Herwig Kainz, Secretary General, ÖGV, Vienna Austria (Vice Chairman); Helga Roder, Managing Director, GfC, Vienna, Austria (Secretary-Treasurer); Dieter Freitag, Bayer AG, Leverkusen, Germany; Paolo Galli, Basell Technology, Ferrara, Italy; Hans Joachim Kaluza, OÖ, Vienna, Austria; Manfred

Raezsch, Agrolinz, Linz, Austria; and Hubert Stueckler, DSM, Geleen, The Netherlands.

Sponsoring Organizations

Oesterreichische Akademie der Wissenschaften, Gesellschaft Oesterreichischer Chemiker, Pacific Polymer Federation, Polymer Institute, Slovak Academy of Sciences, Society of Polymer Science, Japan, Polymer Society of Korea, Division of Polymer Chemistry, American Chemical Society, European Polymer Federation, IUPAC, Division of Macromolecular Chemistry.

Discussion Leaders

P. Corradini (Naples, Italy), H. F. Gruber (Vienna, Austria), O. Hinterhofer (Vienna, Austria), T. Kajiyama (Fukuoka, Japan).



G. Kirshenbaum



Helga Roder



Palais Eschenbach

Conference Report

F. E. Karasz (Amherst, MA, USA), S. C. Kim (Taejeon, Korea), G. Kirshenbaum (Summit, NJ, USA), J. Koetz (Göln, Germany), P. Kubisa (Łódź, Poland), K. Lederer (Leoben, Austria), D. Loidl (Vienna, Austria), O. F. Olaj (Vienna, Austria), H. Roder (Vienna, Austria), J. C. Salamone (Rochester, NY, USA), J. Schurz (Graz, Austria), K. Schloegl (Vienna, Austria), J. Schurz (Graz, Austria), S. Slomkowski (Łódź, Poland), S. Tantayanon (Bangkok, Thailand), M. Zsuga (Debrecen, Hungary).

Honorary International Committee

H. Benoit (Strasbourg, France), L. Boehm (Ludwigshafen, Germany), I. Catic (Zagreb, Croatia), G. George (Brisbane, Australia), E. Goethals (Ghent, Belgium), S. Israel (Texas, USA), G. D. Jaycox (Wilmington, DE, USA), Z. Jodlinski (Zabrze, Poland), V. Kabanov (Moscow, Russia), T. Kajiyama (Fukuoka, Japan), M. Kamachi (Osaka, Japan), E. Klemm (Jena, Germany), K. Komarek (Vienna, Austria), M. Mang (Vienna, Austria), E. M. Pearce (Brooklyn, NY, USA), B. Philipp (Berlin, Germany), J. Pospisil (Prague, Czech Republic), H. Ringsdorf (Mainz, Germany), T. Saegusa (Kyoto, Japan), U. Schubert (Vienna, Austria), P. Sigwalt (Paris, France), C. I. Simionescu (Iasi, Romania), C. Tsvetanov (Sofia, Bulgaria), H. Tuppy (Vienna, Austria), J. von Knorring (Lyngby, Denmark), F. S. Wang (Beijing, China), I. Ward (Leeds, UK), A. Zilkha (Jerusalem, Israel).



St. Stephen's Cathedral



Josef Schurz

The Symposium at the Palais Eschenbach was attended by about 180 people from 30 countries. It brought together highly regarded scientists from around the world as speakers and discussion leaders, and provided a compact medium of scientific interaction in an environment of science, art, and culture that is traditional and unique for Vienna.

This symposium also coincided with the 75th birthday of Professor Otto Vogl (see *Polymer News* Vol. 27, No. 8, pp. 284–286, 2002), therefore several of the activities and presentations were planned to celebrate the occasion.

The symposium *Macromolecules in the 21st Century* started with an opening ceremony with the following speakers:

Ferdinand Gantner, Vice-President, Oesterreichischer Gewerbeverein (Austrian Trade Association)



Tetsuo Kajiyama and Otto Vogl



Joseph C. Salamone and Stanley Israel

Gustav Katlein, Vice-President, Gesellschaft fuer Chemiewirtschaft (Austrian Society of Chemical Industries)
Peter Schuster, Vice-President, Oesterreichische Akademie der Wissenschaften (Austrian Academy of Sciences)
Mathias Reichhold, Bundesminister fuer Verkehr, Innovation und Technologie (Federal Minister for Transportation, Innovation and Technology)

Short versions of the abstracts of the 28 speakers at the Symposium are described in the following.

Robert Gilbert, University of Sydney (Australia): *Understanding the Structure and Synthesis of Starch in Cereal Crops Using Synthetic Polymer Methodologies*

A new era in understanding free-radical polymerization started with the development of pulsed-laser polymerization. For the first time it was possible to obtain reliable values of the propagation rate coefficient. It is now possible to apply the same philosophy to natural systems. Starch is an unusual biopolymer: a homopolymer of glucose, but with a complicated molecular architecture. It exists in two forms: a) amylose, largely linear polyglucose chains with a few shorter polyglucose branches; and b) amylopectin, highly branched glucose polymers.

The molecular architecture (microstructure) determines many of the food properties of starch. Structure property information about starch can be obtained by applying methodologies developed for understanding the molecular weight distribution of synthetic polymers to this natural one. The distributions are obtained by snipping each branch of polyglucose with isoamylase and analyzing each fraction using both distribution functions. Both sets of data are consistent, therefore the rates of enzymatic processes for both chain-growth and chain-stopping processes are proportional to the concentration of glucose monomer. There is also a process that specifically removes smaller chains and/or creates longer ones. This was also deduced by much more elaborate biochemical techniques. This new methodology provides a



Schöenbrunn Castle

novel means of obtaining qualitative and quantitative understanding of enzymatic processes. It also has important implications for design of starch grains for food and nonfood uses.

Koichi Hatada, Osaka University (Japan): *Uniform Polymer in Synthetic Polymer Chemistry*

A uniform polymer is composed of molecules that are uniform with respect to molecular weight and constitution. Natural polymers such as nucleic acids and proteins are known to be uniform with respect to molecular weight sequence arrangement of constitutional units, stereoregularity, and conformation. All this strongly relates to their biological activity. Synthetic polymers usually have a molecular weight distribution. Supercritical fluid chromatography is a highly effective method to isolate uniform polymers from the polymers prepared by living polymerization.

Uniform polymers will allow us to solve ambiguous problems in polymer chemistry due to MWD and are of importance for studies on structure-property relationships in solids and in solutions. Isotactic chloral oligomers with symmetrical structure having methyl-groups at both chain ends were prepared and frac-



Robert Gilbert and Karl Schlögl



Koichi Hatada

tionated into uniform oligomers from dimer to octamer.

A molecular level understanding of the mechanism and stoichiometry in the association process of polymer molecules is possible only by using uniform polymers. Stereocomplex formation between isotactic- and syndiotactic-poly(methyl methacrylates) in acetone were studied and the coexistence of s/i 1:1 and 1:1 complexes was demonstrated. End functionalized uniform polymers can be used for the preparation of uniform polymer architectures such as block, graft, comb, and star polymers and copolymers.

Paolo Galli, Haseil Polyolefins (Ferrara, Italy): *Polyolefins, the Most Promising Large Volume Material for the 21st Century*

The main reason for the successful growth of polyolefins is the inherent complexity of their catalytic systems. After the early commercial disappointments of the 60s and early 70s, the deep commitment of the industry in R&D, which was mostly aimed at the understanding of the catalysis, its improvement and management, had created the basic premises for new versatile processes and a generation of new products and properties. This dramatic improvement of polymer properties and the generation of new materials is the base for commercial success. The early generation of chromium-based and Ziegler-Natta catalysts, after a difficult beginning, progressively accelerated their development. The most recent family of Single Site catalysts, together with a still largely unexploited potential of the previous Ziegler-Natta and Chromium catalysts, are showing the capability to guarantee continuation in the support of the expansion. This development is turning toward low cost, low environmental impact polymers and processes, with the minimum amount of constraints.

Chung Yop Kim, Kyungsang University (Seoul, Korea): *Competition Between Formation of Excimers and Excitons on Photoluminescence of Light Emitting Polymer Blends*

Excimeric emission of photoluminescence from light emitting polymers reduces color purity and quantum efficiency. Chromophores in light emitting polymers are composed of aromatic or heterocyclic planar units that tend to have a dimeric conformation on photoexcitation. Excimeric emission is difficult to eliminate but can be reduced by polymer blending. Suppression of the dimeric emission in polymer blends is observed when the two polymers have a donor-acceptor relationship for energy transfer. The donor is photoexcited but the acceptor generates photoluminescence. The energy transfer between the donor and the acceptor not only reduces the excimeric emission but enhances the quantum efficiency of the light emission. In conclusion, excimer emission is suppressed by employing a donor-acceptor pair system with an efficient energy transfer between them.

Stanislaw Penczek, Centre of Molecular and Macromolecular Chemistry, Polish Academy of Sciences (Lodz, Poland): *Polymerization Mechanisms and Novel Structures Based on Polyadditions*

The speaker discussed the major mechanistic features of cyclic esters polymerization, namely factors affecting molar mass, molar mass distribution, end groups, and kinetics control in polymerization of caprolactone and L-lactide initiated by covalent alkylmetal alkoxides, metal alkoxides, and metal carboxylates. In LA polymerization, Sn(II)-alkoxides appeared to be particularly effective, allowing Mn control in the range from 10^2 up to 10^4 . Conditions enabling side chain transfer reactions to be not only quantitatively determined but also suppressed or eliminated were presented.

The full control of end-groups allowed preparation of macromolecules of a given architecture. Polymerization of caprolactone in the presence of dilactones allowed one-step preparation of high molar mass, highly branched, star-like macromolecules.

Nicolai A. Platé, Topchiew Institute (Moscow, Russia): *Drug Delivery Systems Based on Hydrogels for Oral Insulin Delivery*

The speaker described new drug delivery systems based on



Chung Yop Kim



Supawan Tantayanon

synthetic hydrogels. One of the main points was about systems that can deliver Insulin by oral application. These systems are very promising and are now in the clinical trial stage in Moscow.

Bill Gustavsson, Borealis, AB (Lyngby, Denmark): The Importance of Technology for Polyolefin Properties

Polyethylene was discovered in the 1930s. Several technologies have followed the first high-pressure autoclave for the production of low-density polyethylene. Catalyst developments have allowed the development of new and unique properties of polyolefins. The process of preparing bimodal high-density polyethylene has further extended the range of polymer properties especially for pipe applications. Single site catalysis (metallocenes) for olefin polymerization emerged more than 10 years ago. In spite of optimistic predictions, the penetration of the market has been slow. Gustavsson expects that new inventions and different technologies and production platforms will provide new properties of polyolefins.

Manfred Rätzsch, Agrolinz Melamin GmbH (Linz, Austria): Do Melamine Resins Have a Future as Polymer Materials?

The main applications of melamine resins are the surface coating of wood and laminates for furniture surfaces. Superior properties of melamine are scratch resistance, good thermal and chemical stability, and transparency. Melamine resins are most suitable for indoor application because of their limited UV acidic environmental stability. Another important application of melamine resin oligomers is as crosslinking components in automotive coatings.

Melamine resins are materials of medium cost with the potential of excellent mechanical properties and good fire resistance. Nevertheless, in the last 30 years very little activity existed in developing novel melamine resins. It was only recently that a new melamine ether resin was developed. It is obtained as

a colorless transparent granulate with a thermoplastic processability between 80 and 160°C, which will thermally crosslink above 180°C. The relative low viscosity of this resin allows it to impregnate short fibers, fiber mats, or textiles. The resin is compatible with special organic polymers and increases the impact behavior of the reinforcements. Extrudable melamine/wood compositions for outdoor application are now in the development stage.

Krzysztof Matyjaszewski, Carnegie Mellon University (Pittsburgh, USA): Making Well Defined Polymers the Other Way—ATRP (Atom Transfer Radical Polymerization)

Novel initiating systems for controlled living radical polymerization were recently developed. Copper-based ATRP catalytic systems with polydentate nitrogen ligands, such as aliphatic polyamines, seem to be the most efficient. ATRP is based on reversible halogen atom transfer where the intermediate radicals are capable of propagation. Synthetically, ATRP of styrene, methacrylates, and other vinyl monomers in the presence of Cu complexes provides polymers with a wide range of molecular weights from 2,200 to 2,000,000 and with low polydispersities. Polymers are formed quantitatively in bulk, in solution, and in emulsions. Block, graft, star, hyperbranched, gradient, and periodic copolymers are prepared. The (co)polymers made by ATRP lead to potential applications as components of coatings, polar thermoplastic elastomers, adhesives, surfactants, dispersants, lubricants, additives, and specialty materials in electronic and biomedical areas.

Virgil Percec, University of Pennsylvania (Philadelphia, USA): Nonbiological Macromolecules with Biological Functions

The functions of biological macromolecules are determined by their secondary, tertiary, and quaternary structure and by their one-handed molecular chirality that is most frequently amplified via a helical supramolecular structure. Although the origins of biological chirality continue to represent a debated subject in



Nikolai A. Platé and Johan von Knetting

Conference Report

continuous research, it is believed that the soft order of biological systems is created by a combination of molecular diversity and complexity.

Research focuses on the synthetic strategy for the design of synthetic macromolecules that create order and chirality via similar principles of those of biological systems. First, a rational approach to the design of libraries of conformationally flexible amphiphilic self-assembling dendrons was discussed based on the retrostructural analysis of the lattices generated from their supramolecular dendrimers. It was demonstrated that a large diversity of complex self-assembling dendrons generate supramolecular cylindrical structures that are produced both in dilute solution and in bulk state chiral supramolecular structures based on helical superstructures. The experiments demonstrated that the hierarchical mechanism of folding in these systems is similar to that encountered in biological systems.

Junzo Masamoto, Fukui University of Technology (Japan): *Novel Ring-Expansion Reaction Between Cyclic Formal and Ethylene Oxide*

Polyacetal resins are important industrial engineering thermoplastics with an annual market of 400,000 t. They are produced by polymerization of formaldehyde or copolymerization of trioxane and ethylene oxide. For the copolymerization, an induction period exists before the rapid polymerization into the solid crystalline oxymethylene copolymer, as the initiation mechanism of the copolymerization of trioxane and ethylene oxide. It was initially proposed that trioxane reacts first with ethylene oxide to form 1,3 dioxolane. The reaction of trioxane and ethylene oxide gave several novel cyclic compounds; 3,5 trioxepane was formed and then 1,3 dioxolane, which could be isolated.

Ann-Christine Albertsson, The Royal Institute of Technology (Stockholm, Sweden): *Functionalization of Degradable Polyesters*

L-lactide is one of the most frequently used monomers for the synthesis of degradable bioresorbable materials. The most widely

used synthetic method for the polymerization of cyclic esters is ring-opening polymerization. Many different molecular architectures were obtained by carefully selecting the initiator system and comonomers. Efforts to improve the synthesis of polyesters through catalyst development and initiator modification is ongoing. The incorporation of a functional group in the polylactide chain offers a wide range of possibilities for the synthesis of advanced structures. The speaker discussed the use of two new cyclic tin alkoxides to initiate controlled ring-opening polymerization of L-lactide yielding a series of L-lactide macromonomers.

R. Malcolm Brown, Jr., The University of Texas at Austin (USA): *Cellulose Structure and Biosynthesis: What is in Store for the 21st Century?*

This presentation summarized historical developments in fundamental research relating to cellulose structure and biosynthesis. Advances in the structural area included discovery of a new sub-allomorph cellulose; lattice imaging of glucan chains showing no fringe micelle structure; parallel chain orientation in cellulose; and discovery of nematic ordered cellulose. Major advances in biosynthesis included discovery of the terminal synthesizing complex; isolation and purification of cellulose synthase; *in vitro* synthesis of cellulose; and synthetic cellulose assembly. The presentation focused on molecular biology advances with cellulose including cloning and sequencing of cellulose synthase genes from bacteria, cyanobacteria, and vascular plants. The lecture concluded with ideas about future uses of the accumulating genetic information on cellulose biosynthesis for the textile and forest products industries with possibilities of new global resources of cellulose production.

Dieter Klemm, University of Jena (Germany): *Cellulose Biomaterials: Structure, Design and Future Developments*

The formation and investigation of different types of cellulose materials derived from plants or microorganisms prepared by enzymatic *in vitro* synthesis of chemo-synthesis is an important field of cellulose research. This lecture dealt with cellulose synthesis and its relationship with biotechnological design and medical application as a novel type of biomaterial. The formation of a specific supramolecular cellulose structure and the shaping of the biomaterial during cultivation is an important focus of the design. The biotechnological process starts with D-glucose as a carbon source, and a highly effective strain of acetobacter xylinum, forming a very compact cellulose fleece at the air-liquid interface in high yield of 35-40% during 8-10 days. The advantages of using bacterial celluloses are an ultra-fine network architecture, high hydrophilicity, and moldability during formation. Using a matrix technique, acetobacter xylinum can build up the cellulose as it is a regularly formed tube of different length, wall thickness, and inner diameter. The bacterial synthesized cellulose was designed for applications as cover in experimental micro-nerve surgery and as artificial blood vessel interposition.

Pavol Hrdlovic, Polymer Institute, Slovak Academy of Sci-



Vienna Opera House

ence (Bratislava, Slovak Republic): *Spectral Characteristics of Complex Polymer Structures by Free and Linked Fluorescence Probes*

Fluorescence spectroscopy became a well-established technique, which was applied for a variety of polymer problems exploiting different types of probes. Optically transparent interpenetrating-like network, composed of molar ratio 1:1 of low density polyethylene and a copolymer of styrene-co-butylmethacrylate with a monomer ratio 7:3, were characterized by fluorescence probes based on pyrene chromophore.

Rolf Mühlhaupt, Albert-Ludwigs Universität Freiburg (Germany): *Desktop Fabrication and Materials Design for Rapid Prototyping and Biofunctional Processing*

The progress in free-form fabrication technologies offers attractive opportunities of combining computer-assisted design with computer-controlled manufacturing, without requiring molds. For medical devices, biodegradable parts must be designed and manufactured to fit the demands of the individual patients. New developments of small and affordable desktop machines are expanding the scope of these technologies. Key features of free-form fabrication technologies are computer-assisted layer-by-layer constructions. The computer separates the 3D image into a sequence of layers that are assembled by means of the computer-guided manufacturing process. The development of desktop free-form fabrication technologies and 3D plotting was demonstrated with special emphasis being placed upon biomedical applications in regenerative medicine.

Oskar Nuyken, Technische Universität München (Germany): *Strategies for the Synthesis of Light Emitting Materials*

The speaker presented different strategies for the synthesis of low molecular weight and polymeric materials for organic light-emitting devices. Three kinds of polymers were prepared: a) poly(para-phenylene)s with a well defined number of conjugated chromophores in the flexible main chain; b) tetraphenyl-ben-

zidines with pendent oxetane moieties; c) design of cyclic aromatic amines, which are alternatives to linear polymers with the above mentioned groups in the main chain. The capability of this concept was presented in detail. Selected examples showed the electronic properties and their dependence on structure.

Hajime Yasuda, Hiroshima University (Japan): *Organolanthanide Initiated Block Copolymerization of Olefins with Polar Monomers*

Block copolymerization of ethylene with polar monomers was realized for the first time using conventional organolanthanide complexes as initiators. Initiation of the polymerization of ethylene was followed by the block copolymerization of polar monomers. Methyl methacrylate, alkyl acrylates, and caprolactone were used as comonomers. These block copolymers exhibit excellent dyeing and adhesion properties. The problem was that the molecular weight of the initial polyethylene is less than 20,000. Therefore, an initiator complex with a bridged metallocene structure was designed to provide higher molecular weight of the polyethylene segment.

Dieter Freitag, Bayer AG (Leverkusen, Germany): *Role and Design of Polycarbonates for Modern Technologies*

Polycarbonates with a market of 1.5 million tons/year play an important role as engineering plastics with a high rate of growth. This superior role is based on intrinsic properties and advantageous production processes, but also on the maximal exploitation of the property potential: tailored PCs for optical data storage, TMC-bisphenol PC for high temperature applications, branched PCs for FR-sector, and PC alloys for electronic housings.

Christoph Kratky, Karl-Franzens-Universität Graz (Austria): *Molecular Structural Biology—the 3-Dimensional Structure of Biological Macromolecules*

Knowledge about the 3-dimensional (3D) structure of proteins has virtually exploded. To date, about 20,000 structures of proteins have been determined with atomic resolution, using either X-ray crystallography or NMR spectroscopy. The increase in the knowledge of the architecture of building blocks of living systems is driven by biotechnology offering the possibility to produce virtually any protein in large quantity, provided the gene encoding the protein sequence is available. Knowledge of the 3D structure of a protein is a crucial element for the elucidation of its molecular and cellular function. Kratky used protein crystallography to determine the structure of enzymes with the ultimate objective being to elucidate the mechanisms of their catalytic functions. He chose to determine two enzyme systems: hydroxynitrile lyases and enzymes with a coenzyme B₁₂-cofactor. Hydroxynitrile lyases catalyze the cleavage of cyanohydrin to form HCN, plus the corresponding aldehyde or ketone. Enzymes of this class occur in several thousand plant species, when this cyanogenesis is used as a defense system against herbivora attack. Hydroxynitrile lyases are also used for industrial biocatalysis. While hydroxynitrile lyases catalyze well under



Eberhard Borsig and Pavel Hrdlovic



Christoph Krafczyk

stood chemical reactions, the chemistry of most enzymes with a B_{12} factor is without a precedent from classical organic chemistry. The speaker discussed the enzyme glutamate mutase that catalyzes the interconversion between glutamate and methylaspartate.

Dietrich Braun, Deutsches Kunststoff-Institut (Darmstadt, Germany): *PVC on the Way from the 19th to the 21st Century*

PVC is produced today at 31 million tons/year. It is the second largest plastic after polyolefins and higher than styrene polymers. PVC production and use is growing at a rate of more than 4% per year. PVC was first prepared in the 19th century, but was not recognized as a useful material until 1913. Remarkable milestones in PVC history had an important impact on the development of macromolecular chemistry. Recent topics for further PVC development are emulsion polymerization of vinyl chloride with polymeric surfactants and the controlled free radical polymerization with nitroxyls. Chemical reactions of PVC offer possibilities for polymer modifications. In spite of all the political discussion on environmental dangers and hazards of the chlorine industry, PVC has a great future.

Joseph Put, DSM Research (Geleen, The Netherlands): *New Horizons in Material Development—What can we Learn from Nature?*

Three factors influence the business in polymeric materials: macro-trends in society, developments in science and technology, and the outcome of the present turmoil in the chemical industry. Society: An increasing pressure by society on the chemical industry will demand sustainable products and processes. Science and technology: The development in material science and technology demands increasing control on the molecular and supramolecular level. Principles and approaches of nature are applied to synthetic polymer materials. Nature uses a limited number of building blocks for its materials, which are completely recyclable. Synthetic polymeric materials control on structure formation during processing is still limited and organization on

the molecular level is still difficult. As a consequence, the properties of these materials are still far from perfect. Better control during the molding process could make a big difference.

Nikos Hadjichristidis, University of Athens (Greece): *Synthesis and Morphology of Multiblock Multicomponent Systems*

Synthetic procedures have been established for the synthesis of well-defined ABC, ABCD, and ABCDE linear, as well as ABC and ABCD multiarm, star copolymers. These procedures involve anionic polymerization, high vacuum techniques, controlled chlorosilane chemistry and/or heterofunctional linking agents. Since there are three or more interaction parameters and different space arrangements, these materials generate, as proven by transmission electron microscopy and small angle X-ray scattering, a rich variety of well-defined multiphase micro-domain morphologies, such as four-phase coaxial cylinders, four-phase six-layer lamellae, and honey comb structure, etc. The potential applications of these materials are open, e.g., possibilities as multifunctional sensors or multiselective catalysts for chemical reactions were considered.

Eberhard Borsig, Slovak University of Technology (Bratislava, Slovak Republic): *Polypropylene Grafting as a Tool of New Material Preparation*

Grafting of isotactic polypropylene with unsaturated monomers is one of the most effective methods for modifying polypropylene properties. The objective of this method is to link some polar groups or polar chains onto the backbone of polypropylene in order to produce a polymer, which can then be used in the preparation of polypropylene blends with polar polymers and in composites with inorganic or organic fillers. Properly grafted polypropylene (e.g., with maleic anhydride) improves compatibility of polypropylene with polyamide or polyester blends and it improves adhesion to particles of various kinds of clays, metal surfaces, or natural fibers.



Yoshiki Chino

Yoshiki Chujo, Kyoto University (Japan): *Organic-Inorganic Polymer Hybrids*

Polymer Hybrids are blends of organic and inorganic components at nano-level dispersion. The mechanical strength of the components are enhanced. High transparency is indispensable for optical wave guides, optical biosensors, and contact lenses. Hybrid materials are also potential candidates for catalysts and gas separation membranes. New methods for the preparation of organic-inorganic polymer hybrids were explored.

1. **In-situ polymerization method:** The radical polymerization was carried out together with the sol-gel hydrolysis of alkoxysilanes to produce homogeneous and transparent polymer hybrids and interpenetrating polymer network hybrids.
2. **In-situ hydrolysis method:** The sol-gel reaction of tetraethoxysilane in the presence of poly(vinyl acetate), unlike poly(vinyl alcohol), gave homogeneous products.
3. **Aromatic interaction between organic (polystyrene) and inorganic matrix (phenyltrimethoxysilane).**

The molecular hybrids between organic polymers and silica gel show intermediate properties between plastics and glasses (ceramics).

Bela Ivan, Chemical Research Center, Hungarian Academy of Sciences (Budapest): *New Nanostructured Smart Amphiphilic Polymer Co-networks and Gels*

Amphiphilic co-networks are composed of covalently bonded, but otherwise immiscible and hydrophobic polymer interpenetrating networks. These materials can swell in both hydrophilic and hydrophobic solvents. Due to the special architecture of these polymeric structures, large scale phase separation of the immiscible components is prevented by the chemical bonding in the co-network while local phase separation occurs.

William J. Simonsick, Jr., Performance Resins Department, DuPont (Philadelphia, USA): *Molecular Weighing in the Nanometer Size Regime by Mass Spectrometry*

Mass spectrometry plays an important role in the characterization of polymeric materials because of its sensitivity, speci-



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ficity, and time of rapid analysis. The K^+IDS technique has been employed for the analysis of oligomers and polymers of trihaloacetaldehydes. Compared to other more traditional mass spectrometry techniques, K^+IDS supplied molecular ions without the fragmentation of fragile molecules. It provided a quick evaluation of the synthetic results as the end groups and repeat masses can be compared to theoretical results. This technique has been used to successfully characterize hundreds of novel polymerizable and polymer-bound UV stabilizers. The isotopic distributions of uniform polymers have been recently calculated and examined for the utility of soft ionization method for high polymers. Gel permeation chromatography can be coupled to mass spectrometry through a soft ionization interface (electrospray ionization) to size separate and therefore simplify the compounds entering the mass spectrometer.

Otto Vogl, University of Massachusetts in Amherst (USA): *My Life with Polymer Science*

The speaker gave a review of 55 years of research in industry and academia. 45 years of this research/work was devoted to polymer research. It included polymer synthesis, polymer physical chemistry and even some aspects of polymer physics. Much effort was devoted to aldehyde polymerization: the polymerization of higher aliphatic aldehydes, including the side chain crystallization of isotactic polyaldehydes and the polymerization of trihaloacetaldehydes. The latter work led to the recognition of the importance of the side group bulk for the stereospecific and conformational specific polymerization, cryotachensic polymerization, ceiling temperature, optical activity based on macromolecular asymmetry, and the concept of the single helix. Other contributions were made in polyoxymethylene research, head-to-head polymers and functional polymers, especially polymeric and polymerizable UV stabilizers and polymeric drugs. Reactions on polymers with flexible side chains, including the preparation of mesogenic structures, were also investigated. The speaker also discussed his short-term scientific commitments. He pointed out



In the Grödenbeid. From left to right: Otto Vogl, Gerald S. Kricheldorf, Frank E. Karasz, Petermann Kabis, Tizito Kojima, and Helga Röder

Conference Report

that it is always necessary to recognize novel possibilities and pursue them, and to develop and utilize novel aspects of polymer science and technology. The isotope distribution of uniform polymers was also calculated, which provides the ultimate uniformity in polymer macromolecular structures. A special interest of the speaker's research was polymer science and the arts, or better phrased, polymer science and humanity. Analytical techniques were developed for the active components of oriental lacquer components.

The Symposium started on Sunday, October 6, 2002 with a working dinner for speakers and session chairmen at the Griechenbeisl. It allowed them to get acquainted with each other and to plan for the smooth operation of the Symposium. The Griechenbeisl is one of the oldest edifices in Vienna. It was mentioned in a chronicle in 1447 and was built over Roman foundations. By about 1500 it was known as an inn called "The Yellow Eagle" and later became the Greeks' Inn.

During the lunch hour on Monday, the Austrian broadcasting service interviewed selected speakers (Pearce, Gilbert, Platé,



Griechenbeisl



Presentation of the Culture Prize, 2002, Traiskirchen. From left to right: Fritz Knotzer, Mayor, Otto Vogl, and Hannes Herber

Kratky, Galli, Kajiyama, and Vogl) for a broadcast that aired on Thursday evening.

The banquet on Monday evening was attended by about 120 persons, and was held at the Radisson SAS Palais Hotel. U. Schubert (GOxCh), T. Kajiyama (SPSJ), S. C. Kim (Polymer Society of Korea), A. C. Albertsson (EPF), S. Tautyanon (PPF), and S. Israel (ACS, Division of Polymer Chemistry) presented their greetings for the conference. E. M. Pearce, President of the American Chemical Society, proposed the toast.

On Tuesday afternoon, an excursion was held to Traiskirchen, about 20 miles south of Vienna. It is the birthplace of Otto Vogl.



W. MacKnight and Frank Korte



Mark Medal Presentation. From left to right: Karl Pöngl, Hans Kaluz, Koichi Hatada (medal honoree), Otto Vogl, and Manfred Tacker.

The participants of the Symposium were received by the Mayor and the City Council, which presented the prize of Culture 2002 of the City to Professor Vogl. After a visit to the City Museum, the 160 guests gathered at a buffet dinner. Traiskirchen is a wine

growing town and October is the time of the annual wine harvest. At the dinner the local wines were presented for tasting.

After the conclusion of the Symposium in the early afternoon on Wednesday, the participants of the Symposium were invited by the Mayor of Vienna to the Wappensaal of the City Hall for a reception.

The participants of the conference found the meeting exceptional in the content of the lectures and the foresight that the speakers showed in their presentations. We do not need to be concerned that polymer science and technology in the 21st century is any less exciting and productive than it was in the last century, which was the beginning of the plastics age.

The presentation of the Herman F. Mark Medal was also held, which was not directly related to the Symposium "Macromolecules in the 21st Century." The Medal is presented each year by the Austrian Research Institute of Chemistry and Technology to selected members of the scientific and industrial community. This year's recipients were Koichi Hatada (Osaka University, Japan), Frank E. Karasz (University of Massachusetts, Amherst, MA, USA) and S. Sommers (Senperit Co., Wimpasing, Austria). The Awards were presented in the Marmorsaal of the Federal Ministry of Economics and Labor.
