

**JAPAN-U.S. POLYMER SYMPOSIUM**

**KYOTO, JAPAN - 1985**

By

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The Japan-U.S. Polymer Symposium was held in Kyoto from October 29 to November 1, 1985. Professor Takeo Saegusa, Kyoto University and President of the Society of Polymer Science, Japan, was the Chairman/Japan and Professor T. Higashimura, Kyoto University, Vice President for Foreign Affairs of the Society of Polymer Science, Japan, was the co-chairman/Japan. From the U.S. side, the Chairman was Professor Vogl, Herman F. Mark Professor of the Polytechnic Institute of New York and Chairman of the Committee of Foreign Affairs of the Division of Polymer Chemistry, Inc., ACS; Professor Eric Baer, Case Western University acted as the co-chairman.

This Polymer Symposium was the second Symposium of its kind. The first U.S.-Japan Polymer Symposium was held in Palm Springs, California in 1980 under the co-chairmanship of Professors William J. Bailey and Teiji Tsuruta. This year's Japan-U.S. Polymer Symposium was held at the Kyoto Heian Kaikan Hotel and was attended by over 300 participants, 65 were from the United States. This meeting marked another step forward in the continued close cooperation between the Division of Polymer Chemistry, Inc., ACS and the Society of Polymer Science, Japan, a cooperation which has been effectively progressing for over 10 years between the two largest polymer science oriented societies in the world.

The Symposium consisted of 28 invited plenary lecturers (14 from either side), 48 invited papers and 92 contributed papers, a full schedule for a 3-1/2 day meeting. The meeting provided an excellent opportunity for the participants of the Division of Polymer Chemistry, ACS to meet their Japanese colleagues in Kyoto, one of the leading centers of polymer science in Japan. It was of

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particular importance for the younger polymer scientists from the U.S. and from Japan to interact scientifically and personally, affording them the chance to gain experience in an international scientific activity.

In addition to the meeting itself, a number of other events took place; on Monday evening, the welcoming reception, the traditional beginning of a typical scientific meeting in Japan, was held at the Kyoto Heian Kaikan Hotel. The banquet was held at the Karasuma Kyoto Hotel in Kyoto on Tuesday evening. Following the elegant dinner, a number of talks were given by leading personalities of both organizations reflecting the long traditional collaboration in polymer science and technology between polymer scientists of Japan and the United States. The Chairman of the Division of Polymer Chemistry, Dr. James Economy presented the President of the Society of Polymer Science, Japan, Professor Takeo Saegusa with a unique gift of American sculptured glass by Steuben, in appreciation for the efforts that were extended by the Society of Polymer Science, Japan to organize and host this meeting.

On Wednesday evening, the governing board of the Society of Polymer Science, Japan, hosted a typical Japanese dinner in a traditional Japanese restaurant in Kyoto in honor of the Executive Committee of the Division of Polymer Chemistry, Inc., ACS. In the opening statement, Professor Tsuruta, the former President of the Society of Polymer Science, Japan and presently the President of the Japanese Chemical Society, proposed the toast, and Professor Vogl the prime promotor of the cooperation between the two societies, and former chairman of the Division of Polymer Chemistry (1974), gave the final address.

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On Thursday, the Division of Polymer Chemistry, Inc., ACS, hosted a luncheon for members of the Executive Board of the Society of Polymer Science, Japan and selected young Japanese scientists that had been active in the organization of the Japan-U.S. Symposium. A toast was proposed by Professor William J. Bailey, former President of the American Chemical Society and the final address was given by Professor Seizo Okamura of Kyoto University who expressed the desire for continued and improved cooperation between Japan and the U.S. in polymer science.

When the meeting ended on Friday and the people gathered for the excursion to various interesting sights in the old Imperial City of Kyoto, it was concluded that this was probably one of the most fruitful and successful meetings in Polymer Science. Some of the outstanding contributions were presented by young scientists of the two countries; it was stated that with the quality of their work, the future leadership in polymer science in the U.S. and Japan is guaranteed.

It was proposed that another meeting on Polymer Science involving the scientists from Japan and the U.S. should be held in the not too distant future; it was suggested that such a meeting might involve also scientists of Australia and possibly other countries of the Pacific Basin. During the Symposium, discussions were also held between the Japanese and the U.S. sides for the possible formation of a "Federation of Polymer Science of the Pacific"; these discussions which had begun last year included also Australia. Considerable progress was made in the negotiations during this meeting.

The Japan-U.S. Polymer Symposium was opened by Professor

Takeo Saegusa, the President of the Society of Polymer Science, Japan. He pointed out that the Society was founded in 1951 and has now about 10,000 members. The Society, with its headquarters in Ginza, Tokyo, has an extensive program of meetings, such as their Annual Meeting and their Annual Symposium; it also sponsors a number of additional activities, including the publication of Kobunshi and the Polymer Journal. Day by day operation of the Society is supported by the membership fees to about 20-25% with a considerable amount of industrial support, and some support from the government.

Professor Otto Vogl, former Chairman of the Division of Polymer Chemistry, Inc., ACS, pointed out that the Division was also founded in 1951 and has now reached a membership of more than 8,000, of which 80% are from industry. The Polymer Preprints, issued twice a year, is a widely read, abstracted and highly regarded publication. Dr. Vogl then told the audience how the cooperation between the Japanese and U.S. polymer scientists had developed over the years from initial contacts, visitation of scientists, young Japanese post doctoral students in the U.S., visiting professorships of U.S. professors in Japan and Japanese professors in the U.S, an intensification of exchanges, visitations and bi-lateral U.S.-Japan seminars on Polymer Science on a number of specific subjects. Since 1974, a formal agreement of cooperation has been in effect between the Society of Polymer Science, Japan and the Division of Polymer Science Inc., ACS which has led to important cooperative, joint activities, ultimately leading to the first U.S.-Japan Polymer Seminar in Palm Springs, in 1980. It was pointed out that close cooperation between Japanese and U.S. scientists in polymer science is a very desirable and fruitfull means of promoting interactions in

polymer science and technology. Close cooperation is expected to continue and to intensify as needs develop.

The scientific program started on Tuesday morning with Teiji Tsuruta as the first invited plenary lecturer. In his talk entitled "Amino-Containing Polymers-Synthesis and Biomedical Properties" he mentioned that his group is involved in the preparation of polyamine macromers which were prepared by reacting N,N'-diethylethylenediamine with 1,4-divinylbenzene. He described the mechanism of this addition reaction and the molecular weight regulation. He also mentioned that his group was involved in the study of the reactivity of this polyamine macromer and the copolymerization with styrene which leads to polystyrene-polyamine graft copolymers; the biomedical behavior of these graft polymers was investigated by column chromatography. When a sample of lymphocyte suspension was passed through polymer-coated glass beads, the albumin-precoated surface was capable of differentiating rat lymphnode lymphocyte subpopulations. Further studies of copolymers as column matrix for chromatographic separation of lymphocyte subpopulation is now in progress.

"Hierarchical Structure and Mechanical Function of Polymeric Solids" was the subject of Eric Baer's talk. He described various composites of natural materials. Soft connecting tissues are designed to serve unique functions in mammals, each soft tissue possesses a complex architecture composed of components which are organized into a macromolecular, multicomposite structure. In general, these complex morphologies consist of collagen fibrils embedded in a gel-like matrix, structures which exhibit rate-dependent viscoelasticity to accommodate the need for energy

7

absorption and resistance to the accumulation of damage that could ultimately result in fracture; anisotropic structures insure highly efficient structural specificity. The tissues are reinforced in the direction of maximum stress to serve appropriately in the required mechanical environment.

Akira Furumiya discussed "Olefin Polymerization by Ziegler-Natta Catalysts - Past, Present and Future". The initiating systems are composed of titanium chloride and alkylaluminum compounds which have been used extensively as initiators in olefin polymerization. Furumiya discussed new initiating systems based on magnesium chloride and titanium chloride; it was found at Mitsui Petrochemical Industries that the activities of the initiators for ethylene polymerization were one hundred times higher than the conventional titanium trichloride initiating systems; this was achieved by improving the uniformity of active centers in the initiating systems. Efficient initiators have been developed for the production of copolymers of ethylene with higher  $\alpha$ -olefins. New systems are also now available for propylene polymerization with high initiator activity based on selective addition of electron donors, for example, ethyl benzoate which have both high stereospecificity. The progress in recent initiator technology has enabled the control of particle size and particle shape of the polymer, based on the principle idea that the polymer would be the replica of the initiator particles.

Optical activity arises either from configuration (chirality) or from conformation (macromolecular asymmetry). Otto Vogl in his talk "Polymer Optical Activity Based on Macromolecular Asymmetry" described helical polymers where macromolecular asymmetry

is the only factor contributing to the optical activity of the overall polymer structure; the ultimate goal is to design and prepare polymers which have one hundred percent helical asymmetry. It has now been well established that the polymerization to helical optically active polymers can be carried out by anionic polymerization using chiral initiators where the chirality is a) in the anion or b) in the counter cation. The screw sense and type of helicity is determined by the addition of the initial two or three monomer units to the initiator. Fluorochlorobromoacetaldehyde, one of the key monomers to help solve the problem, was synthesized and polymerized.

"Recent Advances in Polymerization with Expansion of Volume" was presented by William J. Bailey. Research designed to produce monomers that can undergo polymerization with either no change in volume or with slight expansion in volume was demonstrated with bicyclic monomers in which two rings were opened for every new bond formed in the polymer chain. It had been found that spiro ortho esters, ketal lactones, and spiro ortho-carbonates did indeed undergo polymerization with expansion in volume. Heat resistant and relatively oxidatively stable polymers from aromatic spiro-ortho-carbonates have now been prepared which polymerize to the corresponding aromatic ether-carbonates. "Block Copolymers by Iodine-Transferring Radical Polymerization", was presented by M. Tatemoto. Molecular weight control in radical polymerization was accomplished by using chain transfer agents. When perfluoralkyl iodides were used as chain transfer agents to control the molecular weight of fluoroelastomers, polymers were obtained with an unexpectedly narrow molecular weight distribution. This technique



allowed the incorporation of methyl methacrylate segments into of block copolymers when using iodine-transferring radicals.

Richard S. Stein presented the work of his group on "Scattering Studies of Polymer Deformation and Morphology". Scattering techniques are useful for the characterization of polymers in the solid state. Depending upon the size and the nature of the structures being observed, studies have been made using neutrons, x-rays or light. The use of neutron scattering for the determination of the radii of gyration of molecules in the solid state from the dependence of scattered energy is now well documented. A recent development is the use of neutron scattering for the study of miscibility of polymer blends, to follow chain orientations in deformed solids, and to study the network structure of cross-linked elastomers. Other scattering studies such as x-ray scattering, laser scattering using polarized light have also been useful for the elucidation of the morphology of polymer structures, particularly thermotropic crystalline polymers. "Morphological and Kinetic Studies on Phase Separation of Polymer Mixtures" were discussed by T. Hashimoto. Demixing mechanisms for binary liquid mixtures of poly(vinyl methylether) and polystyrene were studied by time-resolved light scattering techniques. The dynamic of the demixing is similar to that of low molecular weight structures.

"Synthesis and Characterization of New Functional Polymers" was described by Joseph P. Kennedy. Investigations of the fundamentals of carbocationic polymerizations have been continued; it was found that aged 2,5-dichloro-2,5-dimethylhexane/boron trichloride systems effectively initiated the polymerization of isobutylene in methylene chloride solution. It was found that the

key compound was a cyclic chloronium structure. Careful study established the functionality of the head group and that of the tail group of polymers prepared by this initiating system. This lead opens a number of new avenues for research on new functional polymers. Seiichi Nakahama presented his work on the "Preparation of Tailor-Made Functional Polymers by Anionic Living Polymerization of New Protected Monomers". He mentioned that anionic living polymerization is the best method for preparing homopolymers and blockcopolymers with controlled molecular weight and narrow molecular weight distribution. Functional polymers with well defined chain structure could not be obtained by anionic initiators because of the high reactivity of initiators and propagating ends toward the functional groups. However, when the functional groups were protected by trialkylsilyl and other protective groups, anionic polymerization could readily be carried out.

"Control of Structure in Polymeric Systems: Some Recent Examples" was described by Rudolph Pariser. Control of physical and chemical structures in polymeric systems is receiving increasing emphasis, since precision of structural configuration is essential for developing new and improved functions for polymers on a wide range of applications. The speaker described new features of group transfer polymerization, the use of benzaldehyde as initiator for silyl enol ether polymerization to silylated poly(vinyl alcohol). A new route to high strength, high molecular weight polyethylene, based on polymerization of ethylene directly to high strength, unentangled polyethylene crystals was described. A new theoretical molecular model, based on the kinetic theory of fractures and a new way of depositing very thin metal interlayers into polyimide films

in a precisely controlled manner was also discussed. M. Kamachi presented his work on "New Developments in the Study of Active Species in Radical Polymerization". Radical polymerization of vinyl compounds has been systematically investigated in the past, but some fundamental problems still remain unsolved: Physical chemical properties of active species of the propagating radicals, complex formation of propagating radicals, direct detection of propagating radicals, conformation of propagating radicals and kinetic study of their polymerization are only some of the areas that need attention.

Shiro Kobayashi discussed "Functional Polymers from 2-Oxazolines". New functional polymers possessing poly(N-acylethylenimine)s chains have been developed. Block copolymers can be prepared by copolymerization in succession. In a one-pot reaction, graft copolymer could be prepared with nonionic polymer surfactants by ring opening copolymerization of a polymerizable macromer, for example 2-vinyl-2-oxazoline; it was also found that poly(N-acetyleneimine) was miscible with a number of polymers or can act as "compatibilizer".

"Radiation Induced Cationic Polymerization" was the subject discussed by Vivian T. Stannett. The speaker has studied the rate of cationic polymerization initiated by high energy radiation in the liquid state and under super-dry condition; his work has now been extended to ring-opening polymerization in the liquid state. Unlike the chemical initiation with strong protonic acids, the radiation initiation is not complicated by concurrent condensation reactions. Masao Doi described his work on the "Stress Optical Law". He pointed out that the stress optical law is an experimental relation found in rubbery materials and states that in such materials a

linear relation exists between stress and birefringence even if the rheological properties of the material are highly nonlinear. This simple relation holds even when the system shows a remarkable nonlinearity and memory effect. Ronald K. Eby presented his work on "Structures and Defects in Crystals of PTFE". PTFE and copolymers of TFE and HFP exhibit at least three conformations in the solid state which show as four crystal phases and are responsible for a range of distinct physical properties. Some of these phases have been known for some time, but their structures have not been established. A more detailed knowledge about the structure and disorders will give more realistic models of the transitions between phases. The session was concluded by James Economy on the "Ordering Processes in Aromatic Polyesters". Liquid crystalline aromatic polyesters and polyamides have been introduced commercially in the early 1970's; aromatic liquid crystalline polyesters can be formed or fabricated in the liquid crystalline melt. The author presented a very brief review of the early work on polyesters and described in some detail the idea of molecular ordering processes and structures which have been observed in liquid crystalline polyesters in both homopolymers and copolymers.

The Thursday mornings session was opened with a presentation of Toyoki Kunitake on "Preparation of Polymerized Bilayers". Kunitake was responsible for much of the early work on bilayer membranes; he pointed out that bilayers are formed by self assembly of natural phospholipids and a large number of synthetic amphiphiles. The preparation of polymerizable bilayer membranes and the property of the resulting polymerized membranes have now been studied extensively by a number of research groups. The

stabilization of bilayer vesicles by polymerization was a major target of these studies. The new direction in polymerized bilayers research involves the self organization of reformed polymers. Kunitake pointed out that appropriate copolymers of hydrophylic monomers with double alkyl side chains and hydrophilic monomers give vesicles when dispersed in water. Bilayer membranes are also obtainable from appropriate homopolymer; vesicles of ionene polymers are interesting examples. The utilization of anionic polymerization techniques has permitted the synthesis of well defined block copolymers as described by David M. Braunstein in his talk on "Macromolecular Monomers". These Macromer monomers are relatively low molecular weight polymers with a terminal group capable of further polymerization to produce copolymers with a comb type structure. Macromonomers of the polystyrene type were copolymerized by conventional radical polymerization, for example, with acrylate monomers; they gave polymers which were thermodynamically incompatible. The copolymer segments separated into microdomains, some of them are smaller than the wave length of light. Akio Imai presented his work on "Molecular Design for the Improvement of Rolling Resistance of Butadiene Rubbers". A great deal of interest has recently developed in tire rolling resistance or energy waste in tire performance. It was recognized that these properties are governed by the type of polymers used as the tire materials, the polymer structure, molecular weight or molecular weight distribution of the polymer and the tire construction. Anne Hiltner presented her work on "Reversible Gelation of Macromolecular Systems". Atactic polystyrene undergoes thermoreversible gelation in various solvents. The gel state seems to be an equilibrium state; she

indicated that gelation is a distinct and separate phase transition; the phenomenon is not the glass transition of highly plasticized polymer. "Behaviour of Thermotropic Liquid Crystal Polymers" was presented by G.E. Williams. The new thermotropic liquid-crystalline polymers are ultra high performance material with an excellent balance of thermal, electrical, chemical resistance and flame-resistance properties. They can be fabricated by a wide variety of techniques including injection molding and extrusion. Junkichi Sohma presented his work on "ESR Studies on Molecular Motion of Polymers". He pointed out that ESR line-shape changes depend very much on the orientation against the magnetic field. When the molecules become mobile, the ESR line-shape narrows by the motional averaging of the anisotropic factor. Spin-labeled poly(methyl methacrylate) samples were studied and the detection of anisotropy of the molecular motion as well as the detection of local inhomogeneity through molecular motion was investigated. The ESR spectra consist of two components: one derived from the rigid part of the molecule and one from the mobile part, in spite of the fact that the normal PMMA molecule is considered homogeneous. Paul C. Painter gave his talk on "Infrared Spectroscopic Studies of Hydrogen Bonding in Polydiacetylenes". Polydiacetylenes with urethane substituent groups, display thermochromic transitions in the solution and in the solid state. The planar conformation of the stiff conjugated backbone of these polymers are stabilized by intramolecular hydrogen bonds between the side chains. It was found that there is a range of hydrogen bonded states that vary systematically with temperature. "Structure-Property Relationships in Conducting Polymers" was discussed by Stephen H. Carr.

Recognition of the important requirements for the molecular organization of polymeric solids has achieved the highest level of electronic conductivity. Molecular organization accomplished three things to aid conductivity: an ordered conformation of the chains sufficient to permit extensive delocalization of electrons, a chain packing which aids the transport of charge carrier from chain to chain, and a morphology suitable for providing conducting paths from one side of the specimen to the other. Conducting polymers based on metal phthalocyanine-based polymers have proven useful in testing these concepts. This is especially important because such polymers were found to be air stable and relatively robust when exposed to electron beams.

The Friday morning session was opened by L. Guy Donaruma on the "Polymerization of Atropic Acid( $\alpha$ -Phenylacrylic Acid) and its Derivatives". High molecular weight polyelectrolytes have been under investigation as candidates for enhanced oil recovery. Many polymer candidates are based on polyacrylamides or similar compounds; the problem of hydrophylicity in the backbone versus the side group and polymer stiffness has been the key element of this investigation. These properties have been studied recently and compared; as a new polymer type, derivatives of atropic acid have been investigated. Kazuyuki Horie presented his work on the "Dynamics of Photoreactions in Polymer Solids". He discussed the effect of structure of molecular motion of polymer matrices on the reactivity or sensitivity of organic photosensitive chromophores. These structures play important factors in photoresists, photomemories, UV curable coatings and in other applications. The author discussed photochromic reactions of spirobenzopyran in polycarbonates,

photoisomerization reactions of azobenzene in polycarbonates, and the phosphorescence decay in various polymer matrices. The final presentation was by J.C. Salamone on the "Polymerization of Ion-Pair Comonomers". The synthesis of the charge-transfer ion-pair comonomers 4-vinylpyridinium/p-styrenesulfonate and its quaternary analog, 4-vinyl-N-methylpyridinium/p-styrenesulfonate, was described in detail. In these comonomer pairs, one component is highly electron withdrawing, while the other is strongly electron donating. Spontaneous polymerization of ion-pair copolymers in water had been observed and the corresponding alternating copolymers were obtained. The author discussed also the mechanism of this spontaneous polymerization and the solution property of these and other polyampholytes.

A number of invited papers of 25 minute duration were given; the titles and speakers are mentioned below:

"Macrophage Activation by Polyanions Derived from Maleic Anhydride" by R.M. Ottenbrite; "Reactive Crosslinked Polymers. Copolymers of Maleic Anhydride and Diethylene Glycol Bis(allyl carbonate)" by S.J. Huang; "Polycationic Biocides: Molecular Weight Dependence of Antibacterial Activities" by T. Ikeda; "Macromolecular Engineering of Bilayer Membranes" by D.A. Tirrell; "Polymerized Vesicles; New Materials and Directions for Chemistry and Biology" by D.F. O'Brien; "Selective Oxygen Permeable Membranes from Oligosiloxanes" by Y. Kawakami; "Alcohol-Water Separation by Copolymer Membranes Comprizing Hydrophilic and Hydrophobic Monomers" by S. Yamada; "Palladium Catalysed Vinylic Substitution of Aryl Halides on Polymeric Supports" by W.H. Daly; "The Benzylation of Polystyrene by Friedel-Crafts Reactions: Effect of Polymer



Microenvironment" by Y. Okamoto; "Chemisorption and Polymerization of Olefins on a Medium Pore Size Zeolite" by C.S.H. Chen; "Recent Developments in Lanthanide Catalyzed Polymerization" by H.L. Hsieh; "Synthesis of High Molecular Weight Stereoblock Polypropylenes: A Novel Elastomeric Homopolypropylene" by J.W. Collette; "Developments in the Chemistry of Perfluoroelastomers" by A.L. Logothetis; "Silicon Polyetherimide Copolymers" by J.W. Verbicky; "Solid Phase Polymer and Block Copolymer Syntheses by Iniferter Technique" by T. Otsu; "Particle Nucleation in Unimodal Emulsion Polymerizations" by R.W. Novak; "Living Cationic Polymerization of Vinyl Ethers with a Functional Pendant Group" by M. Sawamoto; "Photogeneration of Cationic Initiators by Donor-Acceptor Interactions. Ag(I), Cu(II) and Onium Salts as Acceptors" by S.P. Pappas; "Synthesis and Chemical Behavior of Polymers Containing Tetrahydrofuran Rings" by J.A. Moore; "Step Reaction Polymerization Involving Oxazolines" by B.M. Culbertson; "Unsolvated Trialkyl Aluminum Compounds Activated with Group I Metal Alkoxides as Initiators for 1,3-Butadiene Polymerization" by A.F. Halasa; "Polymeric Delocalized Carbanions" by B. Gordon III; "Preparation of Highly Isotactic Poly(methyl methacrylate) with Narrow Molecular Weight Distribution" by K. Hatada; "Succinonitrile Polymerization Revisited" by G.E. Wnek; "Synthesis of Polyimidines and Their Analogues" by P.E. Cassidy; "Optical Recording in Polymer Media" by J.M. Pearson; "Analysis of C-13 NMR Spectra of Polypropylene with a Term of Bi-Catalytic Center Model" by R. Chujo; "The Liquid Crystalline Structure of Poly(alkyl L-glutamate)s" by Y. Uematsu; "On the Equation of State of Polymer Melts: Homopolymers, Blends, and Copolymers" by P. Zoller; "Miscibility Behavior of Polymer Blends in the Presence of One or

More Solvents" by D.T. Wu; "The Polymer-Polymer Interface" by D.J. Meier; "Sorption of Methane and Carbon Dioxide in Plasticized Poly(vinyl chloride)" by J.R. Fried; "High-Performance Films: Poly(ether-ketone)s" by C.E. Scroog; "Simultaneous Synchrotron X-Ray and DSC Studies of Polyurethanes" by J.T. Koberstein; "Polymer Analysis by Pyrolysis-Chemical Ionization Mass Spectrometry" by S.C. Israel; "Internal Chain Conformations of Comb Polymers" by A. Miyake; "The Thermal Behavior of Polyenantomers and Polyracemates" by R.E. Prud'homme; "UV-Visible and Fluorescence Characterization of Epoxy Network Polymers Using Chromophore Labelling" by C.S.P. Sung; "Photoinduced Electron Transfer in Polymeric Systems" by M. Yamamoto; "P/N Junction of Polyacetylene Formed by Ion Implantation Technique" by H. Sasabe; "Electrical Conductivity of Heteroaromatic Ladder Polymers" by O.K. Kim; "A Non-Linear, Isochronal Constitutive Equation for Isotropic Glassy Polymers" by R.F. Landel; "Formation and Properties of Thermosetting and High Temperature Polymers" by J.K. Gillham; "Structures of Crystals and Liquid Crystals of a High Modulus Polyazomethine" by Y. Chatani and the "Direct Measurement of Forces between Polymer Layers" by M. Tirrell.

A number of contributed papers were presented; a number of them are of great importance and their titles are outlined below:

"Synthesis and Membrane Properties of Hydrophilic Poly( -amino acid) as Biodegradable Materials", "Synthesis of A-B-A Tri-Block Copolymers Containing Poly(amino acids) and the Behavior of Cell Growth on Their Membranes", "Glucose-Responsive Insulin Release from Polymer Capsule", "Catalytic Action of the Starch Derivatives Having Histidyl Groups as Substituents", "One-Dimensional Aromatic Crystals in Solution-Sequential Polypeptides Carrying Naphthyl Chromophores", "The Electrically

Modulated Permeability Control of Bilayer-Films", "Active Transport of Organic Acids through Poly(4-vinylpyridine-co-acrylonitrile) Membranes", "Transport of Metal Ions through Poly(vinyl chloride) Membranes Containing N-Methyl-N-carboxymethyl Dithiocarbamate Group as a Fixed Carrier", "Control of Chiral Recognition Ability of Polysaccharide Derivatives as Stationary Phases for HPLC", "Reversible Oxygenation with Cu-Complex of Branched Chain Ureanized Heptaethylene Octamine", "Radiation and Thermal Degradation of Polyacetylenes Having Bulky Substituents", "Photodegradative Behavior of the Copolymers Bearing o-Acyloxyimino Groups in the Solid Phase", "Pulse Radiolysis Studies on Reaction Mechanism of Silicone Based Negative Electron Resist", Charge Transfer Interactions between Polystyrene and Aluminum Copper (I) Chloride", "Cation Binding Properties of Poly(crown ethers) with Photodimerizable Groups", "Reversible Absorption of Nitrogen Oxide with Resin-Immobilized Iron (II) Complex", "Separation of Ethylene by Solid Adsorbents Composed of Copper (I) Chloride and Ion Exchange Resins", "Electric Properties of Complexes between Electron Donating Polymers and Aluminum Copper (I) Chloride", "Rechargeable Battery and Photovoltaic Cell Using Electrochemically Doped Poly(N-Vinyl carbazole)", "A Novel Conducting Polypyrrole Modified with Functional Molecules through Doping Process", "Plastic Optical Fibers for Near-IR Transmission", "Control of Refractive Index in Epoxy Resin by Fluorination", "Copolymerization of Phenylacetylene with Elemental Sulfur and Sulfur Dioxide", "Initiation Mechanism of Uncatalyzed Polymerization in the Presence of Copper (II) Ion", "Block Copolymers Derived from Azobiscyanopentanoic Acid", "Synthesis of Inclusion Compounds of Dehydrohalogenated Polymers in

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Deoxycholic and Apocholeic Acid Canals", "Photopolymerization of Diethyl p-Phenylene Diacrylate in the Solid State and Properties of Resulting Polymer", "Polyaddition of p-Diethynylbenzene with p-Benzenedithiol by UV-Irradiation in the Solid State", "Modification of Low Density Polyethylene Film Using Polymerizable Surfactants", " Polymerization Behavior of 7,7-Dicyanobenzquinone Methide as as Acceptor Monomer", "'Immortal' Polymerization: Polymerization of Epoxide Catalyzed by Aluminum Porphyrin-Alcohol System", "Synthesis of Novel Polyesters Containing Tetrahydropyran Rings in Their Main Chains by Ring-Opening Polymerization of Bicyclic Lactones", "Synthesis and Enzymatic Hydrolysis of Regioselectively Modified Stereoregular Polysaccharides", "Polymer Membrane Having Transmembrane Domain from Synthetic Polypeptide", "Synthesis of Polysiloxane Graft Copolymers by Hydrosilylation Reactions", "Structure and Reactivity of 'Living' Polypropylene Prepared with Soluble Vanadium-Based Catalysts", "Copolymerization of Carbon Monoxide and Schiff Base", "Aminimides as Curing Agents for New Uses of Epoxy Resin", "Anionic Polymerization of Ethyl Trifluoromethyl acrylate", "Polymerization and Copolymerization of N-Phenylmaleimide with Organozinc Compounds Formed in Diethylzinc-Methanol System", "Synthesis of New Optically Active Monomer by Addition Reaction of  $\alpha$ -Phenylethylamine to 1,4-Divinylbenzene", "Synthesis and Polymerization of Hydrophilic Macromers", "Synthesis and Properties of Polybutadiene-Polyamide Multi-Block Copolymers", "Direct Polyesterification with Thionyl Chloride in Pyridine", "Synthesis and Properties of Poly(imide-ester)s Derived from Bis(hydroxyphthalimide)s", "Computational Studies on the Hardening Reaction of Phenolic

Resins", "Negative Photoresists Composed of Allyl-Substituted Silicon-Containing Polymers and a Bisazide", "Dynamic Fluorescence Spectroscopy of Intramolecular Exciplex in Polymer", "Pursuit of Electron Behavior by Methyl Viologen in Solid PVA Matrix Generated by Light of  $\gamma$ -Ray Irradiation", "Two Dimensional NMR Studies of Some Synthetic Polymers", "The Structural Change of a Nascent Bacterial Cellulose Fibril with a Non-Swelling Solvent", "Studies on Interaction between CA and Solvents by C-13 NMR Spectroscopy", "Pulsed NMR Study on the Moisture Sorption Isotherm of Cellulosic Fiber", "Elongational Viscosity of Polymer Melt at Constant Stress", "Nonlinear Viscoelastic Properties of Polymeric Microgel Systems", "Rheo-optical Investigation on Deformation of Domain Structure of Polymer Liquid Crystals", "Molecular Motions in Elastomers under Deformation and during Stress Relaxation", "Measurements of Ultrasonic Velocity and Attenuation under Oscillatory Deformation for Polymeric Solids", "Application of Ultrasonic Spectroscopy to Studies of Polymers", "Correlation between Ionic Conductivity and Dynamic Mechanical Property of Polymer Complex Formed by Segmented Polyether Polyurethaneurea and Lithium Perchlorate", "Physical and Dielectric Properties of Irradiated Polypropylene and Poly(ethylene terephthalate)", "UCST and LCST Behavior in Polymer Blends", "Time Dependence of Submicrocrack Nucleation in Poly(methyl methacrylate) during Stress Relaxation and Cyclic Loading", "Environmental Craze Growth in a Local Stress System at the Crack-Craze Tips", "Sorption Behavior of Carbon Dioxide in Polyimide Films", "Transport and Solution of Gases and Vapor in Poly[1-(trimethylsilyl)-1-propyne]", "Promotion Factors for Active Transport of Various Ions through Polymeric Membranes", "Separation Characteristics of Various Alcohol

Aqueous Solutions through Polysaccharide Membranes", "Built-Up Films of Aromatic Polyazomethines Synthesized at the Air/Water Interface", "Fractal Structure of Molecular Random Motions of Polystyrene Latex and Bacteriophage T4 Particles", "Attractive Force in the Ordering Formation of Pure Charged Colloids", "Time-Dependent Process of Counterions around Macroions", "On the Diffusion Constant of Bundle-like Particles of Single Sarcomere from Muscle Fiber", "Characterizations of the Beta Structure of a Model Polypeptide in Aqueous Solutions", "Factors Influencing the Stability of the Beta Structure of Poly(S-carboxymethyl-L-cysteine)", "Dielectric Normal Mode Process in Solutions of cis-Polyisoprene", "Excluded Volume of Sodium Poly(styrene-p-sulfonate) in Salt Solutions", "ESR Study of Spin-Labeled Poly(L-leucine) in Benzene Solutions", "Study of Heterogeneous Aqueous Solution Containing Surfactant by Fourier Transform Infrared Spectrometry", "Polythiophene-Based Conducting Polymer Alloy Films", "Photovoltaic Effect Based on the Organic Dye/Poly(vinyl alcohol) Junction", "Photoelectrochemical Cell Composed of Polymer-Metal Complex Coated on Liquid-Junction Semiconductor", "Polynucleation of Transition Metal Complexes in Solid Polymer Electrolytes", "Dyeing Properties of Ammonium-Dichromated Gelatin Films for Use in Color Image Sensors", "Surface Structure and Properties of Poly(vinyl alcohol)/Poly(dimethylsiloxane) Graft Copolymers", "Ultradrawing of Polyethylene and Polypropylene Films Produced by Gelation/Crystallization from Solutions", "Quenching Processing for Enhancement of the Radiation Resistibility of Polypropylene Film", "Plane Strain Fracture Toughness in Ethylene-Propylene Copolymers", "Crystallization of Phase of Poly(vinylidene fluoride) from the Melt

under Atmospheric Pressure", "Time-Resolved Light Scattering Apparatus Using a Digital Image Processor", "Crystal Structure of Polyethylene Oxide Complex with Sodium Iodide".

The participants, particularly the younger scientists from both the U.S. and Japan found this Symposium unusually successful; it was hoped that in the not to distant future a similar meeting could be organized.