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SPSJ 50th Annual Meeting, Osaka, Japan, May 23-25, 2001

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SPSJ 50th Annual Meeting Osaka, Japan, May 23-25, 2001

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Yasuhiko Shirota



Tatsuro Ouchi



Convention Center and Rihga Royal Hotel

The 50th Annual Meeting of the Society of Polymer Science, Japan (SPSJ) was held this year in Osaka, from May 23-25, 2001. It was the largest meeting of its kind in Japan. The location of the meeting was in the recently constructed Convention Center of Osaka. Next to it is the Rihga Royal Hotel where many participants stayed. It is located on Nakanoshima island, facing Nakanoshima Street. From the Yodo River branches off on the left side, the Oh River, which divides into two arms, the right is called Dojima River and the left arm, Tosabori River. These two arms encircle Nakanoshima, the "inside" island (naka means "inside"), with its famous promenade on Nakanoshima Street, and Nakanoshima Park.

Professor Tisato Kagiya, of Kyushu University is the current President of SPSJ.

The Society has about 13,000 Members and has its headquarters the Shintomicho-Tokyu Bldg., 3-10-9 Irifune Chuo-ku, Tokyo 104-0042, JAPAN. Dr. Ken-ichi Shida is the Managing Director.

Official meetings of SPSJ are being organized twice a year. In



Taro Kagiya
President SPSJ



N-ichi Shida
Managing Director, SPSJ

the Spring the Annual Meeting is normally held in a major city, like Tokyo, Kyoto, Nagoya or Osaka. In the Fall the Annual Symposium is being generally held in Universities that are not located in major cities. The Annual Meeting as well as the Annual Symposium are attended by a great number of participants, from academia and industry: university professors, junior faculty members, students and industrial scientists and managers. A meeting of this kind may attract 3,000 participants with about 2,000 papers and posters.

This time the Annual Meeting was held in Osaka with Yasuhiko Shirota as the Chairman, Tatsuro Ouchi and Shoubo Minatone (Kuraray Co.) as the Co-Chairmen.

The site where Osaka now stands was originally called Naniwa. This name is still referred to in poetry. In the 7th century, Osaka was the capital of Japan. It has long been a leading commercial and financial center of the country. Osaka is located in the Kinki district (a district surrounding Kyoto the former

imperial capital). The Kinki district, also called the Kansai district, is the cradle of Japanese civilization and the industrial and cultural center of west central Honshu, the main island of Japan. It has as its major cities Kyoto, Osaka and Kobe. The district consists of seven prefectures: Mie, Shiga, Kyoto, Osaka, Hyogo, Nara and Wakayama.

Osaka Prefecture, located at the approximate center of Japan is divided into 23 cities, 10 towns and 1 village. It has about 0.5 % of Nation's entire land area. With a population of 8.8 million or 7 % of the entire population, it is the second most populous prefecture after Tokyo. Osaka is the commercial, industrial and administrative center of western Honshu, sharing the control over the western economy with Tokyo.

Osaka City, with a population of about 3 million is the third largest city of Japan, after Tokyo and Yokohama and is the hub of

Western Japan. It is the seat of the Government of Osaka Prefecture; administratively, the city is divided into 22 wards. The land in the Osaka area is generally flat. The city is built on the deltas formed by the Yodo and the former Yamato river. Both empty into Osaka Bay, and its port is open toward the west. Osaka is criss-crossed by rivers and a number of canals. These waterways have played an important part in the development of the prosperity of Osaka as a commercial city. An extensive network of railroad trains, bus and subway lines connected in traffic hubs handle the enormous number of passengers daily.

Osaka prospered as a castle town and served already in the late 16th century and early 17th century as a center of commerce.

Osaka Castle was originally built in 1586 by Hideyoshi Toyotomi, the then military ruler of Japan. The castle is noted for its magnificent scale and granite, stones of immense size used in the construction of its walls. The castle was almost completely destroyed in 1615 by the Tokugawas who had fought against the Toyotomi's for power. The Tokugawa shogunate later reconstructed the castle to exhibit their prestige, which lasted until 1868, the year of the Meiji Restoration. The land around the castle has been converted into a park.

Osaka Port was originally situated at the mouth of the Aji River, but it was not suited to accommodate large ships; the port was opened to foreign trade in 1868. The new harbor was built east of the old port. It is capable of accommodating 30 vessels at one time. Osaka Port is the nation's third largest trading port after Kobe and Yokohama.

Shitennoji Temple, popularly called Tennoji for short, was founded by Prince Shotoku in 593, earlier than the famous Horyuji Temple near Nara. At present the Shitennoji is the headquarters of the Wahu sect of Buddhism. It has a large number of valuable treasures, including Prince Shotoku's swords and other articles which are designated as "National Treasures".

The SPSJ 50th Annual meeting in Osaka was attended by 3,184 participants. 623 papers and 1346 posters were presented. The highlights of the Meeting were 28 invited papers with authors from Japan and 9 from abroad. The 623 lectures were presented in



At the Poster Session

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oral form in a number of subject sessions: Polymer Physics: Structure and Properties (386), Functional Polymers (223) and Polymer Industry and Technology: Processes and Products (14).

In 8 sessions, 1346 papers were presented in poster format.

Polymer Chemistry: Synthesis and Reactions (478), Polymer Physics: Structure and Properties (249), Functional Polymers (230), Polymers and Environment (112), Polymer Industry and Technology: Processes and Products (20), Biopolymers and Biorelated Polymers (257)

The following Invited Lectures were presented:

Nicolai A. Platé, V. Topchev Institute of Petrochemical Synthesis Russian Academy of Sciences, Moscow, Russia:

Novel Aspects of Drugs Targeting Using Polymeric Hydrogels



Nicolai A. Platé

Macromonomer chemistry based on modified natural physiologically active species has led to the creation of novel synthetic polymeric hydrogels containing chemically or physically immobilized active compounds. This resulted in the synthesis of polymeric affinity sorbents for analytical and preparative purpose, hydrogel chemical reactors for transformation of various substrate onto needed species, chemically active thrombo-resistant coatings

which are able to transform some substrates and target them to the desired directions.

The mimics of some features of natural cells using modified and active polymeric hydrogels resulted in the creation of systems which are able to respond to the changes in surrounding media to allow drug targeting. This approach has lead to the creation of novel insulin-hydrogel preparations for oral administration with encouraging results in animal and clinic tests using insulin tablets.

Otto Vogl, University of Massachusetts, Amherst, MA, U.S.A.: *Isotopically Pure Uniform Polymers*

-in cooperation with Gary D. Jaycox and William J. Simonsick Jr.

Synthetic polymers prepared by random initiation, both addition and condensation polymers, have a molecular weight distribution (MWD), M_w/M_n of 2. Separating the rate of initiation and polymerization, as in the case of living anionic styrene or methyl methacrylate (MMA) polymerization can give polymers with a molecular weight distribution of nearly unity. Living PMMA of a MW of 10,000 and a DP of 100, and a MWD of 1.06 still has about 120 polymeric species centered around the MW of 10,000. Modern style fractionation techniques allowed the separation and isolation of individual species, uni-

form polymers. Uniform polymers are well known in nature, the polypeptides, whose synthesis is guided by DNA.

Uniform polymers are still not the final step toward true uniformity in macromolecules. Each molecule or macromolecule is subject to the natural (terrestrial) isotope compositions. Combinations of the isotopes of the atoms in the macromolecule, forced on us by nature, give a very large number of individual macromolecular species. This composition increases as the molecular weight of the macromolecule increases. The statistical number is the number of isotopic species in the monomer unit to the power of the DP.

Owen W. Webster, University of Pennsylvania, Philadelphia, PA, U.S.A.:

Creative Work on Group Transfer Polymerization

With anionic initiators methyl methacrylate (MMA) can be polymerized at low temperatures which prevented or at least delayed the termination reaction. The answer to this temperature problem came also from Japanese work. Mukaiyama had shown that a silyl enolate would activate double bonds under Lewis acid catalysis. We concluded that a trimethylsilyl (TMS) ketene acetal could create circumstances to cause repeated addition of the monomer methacrylate and could work at or above ambient temperatures. This reaction worked and the group transfer polymerization (GTP) was established. GTP was a polymer chemist's dream: everything that was tried, worked and soon a library of block, star, ladder and telechelic polymers were synthesized.

A search of the literature turned up 872 Journal articles, 108 reviews and 398 patents.

The standard GTP synthesis uses tetrabutylammonium (TBA) benzoate as the catalyst. The catalyst removes a small amount of the TMS group and the resulting enolate adds MMA. The enolate ends are now recapped by silylation with TMA benzoate or form a complex with neutral chain ends. The complex does not add MMA.

Lanthanide coordination polymerization and immortal polymerization seem to be closely related to GTP.

Guy C. Berry, Carnegie Mellon University, Pittsburgh, PA, USA: *Crossover Behavior in the Dependence of the Viscosity of High Persistence Length Chains on Concentration and Molecular Weight*

The dependence of the solution viscosity η of polymers with a relatively high persistence length on the polymer molecular weight and the solute concentration are shown. Examples of data from the literature on several polymers were described. The scaling of η with parameters such as the chain contour length L , the mass per unit chain length $ML = M/L$, with M being the molecular weight, the persistence length λ , and the polymer concentration. The merits of scaling with cL , or $c[\eta]$ are of particular interest, where $[\eta]$ is the intrinsic viscosity.

F. Meeussen, R. Moerkerke, A. Bouwens, R. Koningsveld, E. Nies, and H. Berghmans, Catholic University of Leuven, Heverlee, Belgium:

Phase Relations in the System PVME/Water and the Swelling

Behavior of the Corresponding Networks

Many water soluble polymers demix from their solution in water on heating. The water swollen chemical networks or hydrogels of some of these polymers show a discontinuous swelling behavior around the demixing temperature of their linear homologues. Three different types of such Lower Critical Solution Temperature behavior have been observed. The differences are reflected in the molar mass dependence of their critical conditions, which in turn, determine the temperature induced swelling behavior of the hydrogels. poly(N-vinyl caprolactam) in water behaves in the classical way but a complex Lower Critical Solution Temperature behavior was found with solutions of poly(vinyl-methyl ether).

The liquid liquid demixing in solution of poly(vinylmethyl ether) in water was investigated as was the swelling behavior of poly(vinylmethyl ether) hydrogels. The investigation of the linear and cross-linked poly(vinylmethyl ether) in water clearly illustrates the relation between the Lower Critical Solution Temperature mixing behavior of the linear polymer and the temperature induced swelling of the corresponding hydrogel.

Beat H. Meier, M. Ernst, P. Robyr, M. Tomaselli, J. van Beek, and L. Beaulieu, ETH Hoenggerberg, Zürich, Switzerland;
Solid-State NMR Methods to Elucidate the Local Structure of Polymers

Solid-state NMR is one of the few methods that can deliver detailed atomistic structure information for materials without long-range order. This information is a prerequisite for the definition of structure/function relationships. Various NMR methods can deliver internuclear distances and bond- as well as torsion angles. Spin diffusion measurements, double-quantum—single-quantum correlation spectroscopy and distance measurements using recoupling methods in "high-resolution" solid-state NMR are important. Some of the methods require selective isotopic enrichment, others can be performed in unlabelled or uniformly labeled compounds.

The microscopic order (e.g. torsion angles) as well as the macroscopic order are defined in terms of orientational distributions.

Do Y. Yoon, Seoul National University, Seoul, Korea;

Structure and Properties of Polymer Surfaces from Molecular Dynamics Simulations and NEXAFS Experiments

The structural, thermodynamic and dynamic properties of surfaces and thin films of polymethylene and polytetrafluoroethylene melts have been studied by molecular dynamics simulations using explicit and united atom models. Simulations give good agreement for the density and surface tension when compared with experimental data. It is observed that for the n-tridecane the density of the methyl chain-end group is enhanced in the free surface, while it is depleted in the region below the surface. The surface orientation of polymer chains have been measured by near edge X-ray absorption fine structure (NEXAFS) experiments. Detailed results have been obtained for the surface orientation of perfluoroalkyl side groups of

perfluoroalkyl-substituted polymethacrylates. The surface energy is closely linked to the structural order in the surface region, which in turn is limited by the bulk order.

Yong Soo Kang, Korea Institute of Science and Technology, Cheongryang, Seoul, Korea;

Solid Polymer Electrolyte Membranes Containing Silver Ions for Olefin/Paraffin Separation

Silver polymer electrolytes are membrane materials for the separation of olefin and paraffin mixtures. Solid polymer electrolyte membranes containing silver ions such as those in AgBF_4 and AgCF_3SO_3 dissolved in polymer solvents such as poly(2-ethyl-2-oxazoline) and poly(vinyl pyrrolidone) facilitate the transport of propylene. The propylene permeation and its pure gas selectivity over propane increased from less than 0.1 gpu to 45 and from about 1 to 450, respectively. High permeability and selectivity were achieved at high feed pressures, which is very important for practical applications. This high performance is predominantly attributable to the extraordinary high loading of silver ions in POZ and PVP solvents.

Charles C. Han, Erik K. Hobbie, and H. S. Jeon, NIST, Gaithersburg, USA;

Structure and Rheology of Polybutadiene/Polyisoprene Blends under Shear Flow

For symmetrical low molecular mass polymer blends, the phase diagram shift and the structure formation and mixing under shear flow has been studied by the combination of small angle neutron scattering, dynamic light scattering and shear light scattering microscopy techniques. The shear suppression of critical temperature and the droplet deformation, breakup and string formation can be explained by theoretical predictions. For high molecular mass and viscoelastic blends of polybutadiene and polyisoprene, the viscoelastic effect plays an important role.

For a near critical low vinyl polybutadiene blend or vinyl polyisoprene blend, the terminal loss modulus above and below the LCST can be well described. For a near critical low polybutadiene and a low polyisoprene blend, the terminal loss modulus above and below the LCST can be described.

Koji Arimitsu, Tokyo Institute of Technology, Midori-ku, Yokohama;

Acid and Base Proliferation Reactions and Their Applications to Photoreactive Materials

Chemical substances which release organic acids or bases autocatalytically were the subject of this talk. The substances are called acid amplifiers or base amplifiers since the numbers of acid or base molecules can be boosted in nonlinear manners as a result of the autocatalytic decomposition of the amplifiers. The autocatalytic reactions to generate catalytic amounts of acidic or basic species are called acid or base proliferation reactions. The authors efforts have been focused not only on the development of the amplifiers, but also on how to combine the acid or base amplifiers with

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photo-acid or -base generator systems, since a very small amount of photogenerated acidic or basic species may be used to result in drastic enhancement of subsequent acid- or base-catalyzed reactions to provide novel photo-polymer systems with high sensitivity.

Yoshiki Chujo: Kyoto University, Yoshida, Sakyo-ku, Kyoto:
Organic/Inorganic Hybrid Polymers



Yoshiki Chujo

The synthesis of new molecular composite materials has been explored. This talk described "Organic/Inorganic Hybrid Polymers" including the following topics: (1) Various organoboron π -conjugated polymers; (2) Chiral phosphorus-containing main chain polymers; (3) Organo-arsenic polymers; (4) Soluble and processable polymer hybrids starting from functionalized cubic silsesquioxanes; (5) Organic-inorganic polymer hybrids by means of new interactions between two components; (6) Selective crystallization of calcium carbonate controlled by the structure of organic polymers; (7) Metal nanoparticles protected by organic polymers and their self-assembly. These organic-inorganic hybrid polymers are expected to show promising electronic, optical, magnetic, and catalytic properties.

Haruma Kawaguchi: Keio University, Hiyashi, Yokohama:
Fundamentals and Applications of Polymeric Microspheres -- Focusing on Their Faces and Hairs



Haruma Kawaguchi

Wide and varied surfaces are attractive advantages of polymeric microspheres. The surface chemistry and morphology of microspheres are made-up in the course of microsphere-forming polymerization or by modifying the existing microspheres. In the former, polymerization ingredients such as initiators, surfactants, stabilizers and comonomers can play important roles to decide the surface properties of microspheres. Among the modifications of surfaces of existing microspheres, living radical graft-polymerization has become a most promising method to introduce "hairy" structures on the surfaces.

Initiator and UV irradiation were useful for the preparation of thermo-sensitive hairy microspheres. We were also successful in the formation of a variety of hairy microspheres whose hair structures were controlled by the mode of comonomer charge.

Masahiko Sisido: Okayama University, Tsushimanaka, Okayama:
Proteins with Artificial Functions

A biosynthetic system was used for the incorporation of non-natural amino acids into proteins. A tRNA was chemically aminoacylated with a non-natural amino acid and the latter was added to an *E. coli* *in vitro* protein synthesizing system. The positions of the nonnatural amino acids were directed by using four-base codon/anticodon pairs. Applications of the mutagenesis were presented. The nonnatural mutants were also chemically synthesized. A Cro protein that carries an anthraquinonyl group was synthesized and the mutant was found to photocleave dsDNAs.

Yoshiharu Kimura, Kyoto Institute of Technology, Matsugasaki, Sakyo-ku, Kyoto:

New Development of Biodegradable Polymers

A wide variety of screening tests have been carried out to discover useful biodegradable polymers for the past decade. Three types of aliphatic polyesters have emerged as practically useful bioplastics which have good degradability in natural environment and show proper cost performance. These are poly(L-lactic acid), poly(3-hydroxybutyrate), and poly(butylene succinate). Their biodegradability was confirmed by the composting test, although their degradability in other environments is somewhat different. Since these polymers have different mechanical properties, they should possess their own applications as films, sheets, injection moldings, or fibers depending on their characteristics. Poly(L-lactic acid) that can be prepared from various renewable natural resources has been found convincingly to be the most useful. It will be manufactured in the near future, on a large scale at low cost. The author presented an overview of new synthetic methods of poly(L-lactic acid), that can possibly improve its cost performance.

Mitsuru Satoh, Tokyo Institute of Technology, O-okayama, Meguro-ku, Tokyo:

Multiplicity of Interactions in Polymer/Water Systems

Structure and function of biopolymers stem from multiple interactions with water through many kinds of hydrations. Elucidation of the cooperative, competitive and concerted involvement of such interactions, i.e., van der Waals, electrostatic, hydrogen-bonding, hydrophobic, etc., should be essential for molecular design of functional polymeric materials in water systems. Recently, it has been found that hydrogels such as poly (N-isopropylacrylamide) show a marked ion-specificity for the swelling behavior, i.e., a kind of Hofmeister Series. The author has proposed a model mechanism for the ion-specificity; stability of hydrogen-bonding hydration of polar groups on the pertinent polymer is per-

turbed by changes in the water's ability for electron pair donation and acceptance via ionic hydration. This model proved to be effective in many hydrogel systems including poly(vinyl alcohol), poly(vinylpyrrolidone), poly(allylamine), and poly(acrylic acid).

Toshio Masuda, Kyoto University, Yoshida, Sakyo-ku, Kyoto:
Synthesis and Properties of Novel Functional Conjugated Polymers

Conjugated polymers exhibit interesting properties such as coloration, electrical conductivity, luminescence, and non-optical properties, and hence they are under intensive research. They are working on the synthesis and characterization of novel polymers, especially functional conjugated polymers which possess both conjugated systems and functional groups. The talk focussed on the following topics: (i) living polymerization and block copolymerization of substituted acetylenes, (ii) substituted polyacetylenes as gas- and racemate-separation membranes, (iii) helical poly(propionic esters) and related polymers, and (iv) conjugated polymers containing functional groups along the main chain.

Tomohisa Norisuye, Kyoto Institute of Technology, Matsugasaki, Sakyo-ku, Kyoto:
Studies of Polymer Gels at a Molecular Level

Time-resolved dynamic light scattering has been developed in order to investigate a gelation process *in situ*. This enables them to study a mechanism of gelation and a structure of gels by taking account of structural inhomogeneities and a self-similarity in cross-linking clusters. The gelation threshold was successfully determined by an appearance of the strong fluctuations in scattered intensity, a power-law behavior of the intensity correlation function, the reduction of the initial amplitude of intensity correlation function and broadening of the decay time distribution function. The Panyukov-Rabin theory was applied in order to reproduce the scattering functions obtained by small angle neutron scattering for a series of gels having different cross-linking densities. The cross-linking density dependence for the degree of polymerization between cross-links and the correlation length obtained by the analysis were discussed.

Ikuyoshi Tomita, Tokyo Institute of Technology, Midori-ku, Yokohama:
Synthesis and Functions of Polymers Containing Metal Atoms in the Main Chain

Polymers containing metal atoms in the main chain are expected to serve as novel reactive and functional materials. The recent progress in the synthesis and reactions of organometallic polymers, and potential functions of organometallic polymers were reviewed. Polymers having cobaltacyclopentadiene moieties were obtained by the reaction of diynes with a Co(I) complex which can be converted to organic polymers possessing various main chain structure. Likewise, organotitanium polymers were prepared by the analogous reactions which potentially serve as reactive polymers leading to organic materials. The organocobalt polymers can also be con-

verted to metallocene-containing polymers by appropriate polymer reactions. Regioregular organometallic polymers containing cyclobutadienecobalt moieties were prepared by the polycondensation of monomers possessing organocobalt moieties. These polymers exhibited high thermal stability, thermotropic liquid crystallinity, and unique electrochemical properties.

Takashi Miyata, Kansai University, Suita, Osaka:
Preparation of Intelligent Gels Using Biomolecular Interactions

The authors group has synthesized novel stimuli-responsive gels that undergo swelling changes in response to specific biomolecules, using biomolecular interactions such as lectin-saccharide interactions, antigen-antibody bindings at cross-linking points in gels. Glycopolymer gels containing lectin showed glucose-responsive swelling changes due to complex dissociation between lectin and glycopolymer in the presence of free glucose. Bioconjugate gels having antigen-antibody bindings at cross-linking points exhibited reversible swelling changes in response to a specific antigen. Glycoprotein-responsive gels were prepared by biomolecular imprinting using antigen and lectin as legands for a glycoprotein. The fascinating properties of these biomolecule-responsive gels suggest that they have many future opportunities as intelligent materials in biochemical and biomedical fields.

Yoshinobu Tsujii, Kyoto University, Gokashou, Uji, Kyoto:
Controlled Synthesis of Polymer-Brush Surfaces by Living Radical Polymerization and Their Characterization

Atom transfer radical polymerization technique using the copper(I)/Ligand complexes was successfully applied to the surface-initiated graft polymerization of methyl methacrylate, styrene, and other monomers on a silicon wafer, silica particles, and porous materials, giving well-defined, high-density polymer brushes. The direct force measurements by atomic force microscopy revealed that the graft polymers in a polymer brush were almost fully stretched in a good solvent and highly resistant to compression. In addition to the control of chain length, length distribution, and graft density, the substrate surface with a patterned graft layer could also be prepared by the combination with a lithographic technique. These achievements open up a new route to "precision" surface modification.

Masayoshi Okubo, Kobe University, Nada-ku, Kobe:
Designs and Syntheses of Functional Polymer Particles

Syntheses of micron-sized, monodisperse, functional polymer particles from the viewpoint of particle design have been carried out. Our recent results on some topics such as size, monodispersity, shape, distribution of functional groups, unique morphologies, and hollow structure will have been described.

Tetsu Yonezawa, Nagoya University, Furo-cho, Chikusa-ku, Nagoya:
Preparation of Controlled Nanoparticles and Their Ordered Arrays

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Otto Vogl Mikiko Shima Sei-ichi Nakahama

Preparation and application of nanoparticles are the subject of intense investigations. The preparation of size controlled metal nanoparticles by using polymers and coordinative ligands as stabilizer molecules are important. By reducing the metal ions with alcohol in the presence of water-soluble polymers, fine and highly monodispersed metal nanoparticles were obtained, especially, bimetallic nanoparticles with unique particle sizes. Reduction of metal ions by NaBH_4 in the presence of thiols also gave highly monodispersed particles. Cationic metal nanoparticles coated with quaternary ammonium groups gave a one-dimensional ordered array with DNA molecules as templates. Fluorocarbon-stabilized metal nanoparticles also gave an ordered hexagonal packed structure with the uniform edge-to-edge interparticle distances.

Hiroaki Aota, Kansai University, Suita, Osaka :

Water-Soluble, Small Band Gap Polymers

Water-soluble, "small band gap" polymers were prepared from pyrrole with sodium *o*-benzaldehydesulfonate by addition-condensation polymerization. The band gap of polymers was less than 0.22 eV from the absorption edge of IR spectrum.

In order to construct an artificial photosynthetic system, the long-range energy and electron transfers were studied using the small band gap polymers as "molecular wire". The fluorescence study suggests that over a 30 Å long-range photo induced energy and electron transfers occurred with a through-bond mechanism.

Takushi Saito, Tokyo Institute of Technology, O-okayama, Meguro-ku, Tokyo:

Laser Application for Experimental Analysis and Structure Control in Polymer Processing

Two examples of laser application technique for polymer processing were described. One was the use of the interference fringes of He-Ne laser to study generation mechanism of surface profiles, also called cold-mark, during the processing of the temperature data via infrared thermograph, generation process and governing factor of the cold-mark. YAG laser of a wavelength of 1063 nm was used as radiation heating source to selectively heat the specific region in a polymer blend material. Using this technique, the viscosity ratio

of the blend during the mixing was controlled. The final morphology of the test blends were studied by scanning electron microscopy.

Toshihiko Nishiyama, NEC Corporation, Sagami-hara-shi, Kanagawa:

Proton Polymer Batteries

Proton polymer batteries have used proton exchange polymers as electrode materials with polymers on the positive and negative electrodes, only the proton takes part in the transfer of electrons. Other features are important:

1. Easy-use devices; Since the proton that supports loading consists of smaller ion hemispheres, damage to the electrode active material in the polymer structure is minimal.

2. Free of pollutants; As materials such as metals and halogen are not used, the environmental load of the device is reduced.

3. Energy density as high as lead batteries; Use of redox reaction, achieved by using protons, gives 10 times the energy density of double-layer capacitors and a similar level to that of lead batteries

Masayuki Endo, Matsushita Electronics Corporation, Minami-ku, Kyoto:

Status of Photoresists



Ken-ichi Shida Tisato Kajiyama Nicolai A. Platé

With the increase of semiconductor capabilities, the progress of technology for the devices is being accelerated. For 70 nm node and 50 nm node, the expected years of the mass production of devices were expected for 2005 and 2007, respectively. Among the lithography technologies, F2 lithography and electron-beam projection lithography (EPL) are candidates for the 70 nm node.

The present status and the issues of photoresists for these lithographies were reported. The main issue for F2 resists is the transparency of the polymer. Fluorine-containing polymers are being studied. For EPL resists, KrF resists with high activation energy can be used, however, higher sensitivity than $5\mu\text{C}/\text{cm}^2$ is required in view of the throughput. Resists are the key technology for both lithographies. Acceleration of the development of materials as high performance resist is in high demand.

Yoshinobu Tanaka, Kuraray Co., Umeda, Kita-ku, Osaka:

Study of Micro-structure of Liquid Crystal Polymer Film and Application to Circuit Board

The molecular orientation ratio describing the opacity of films of liquid crystal polymers was measured by a microwave technique. Former theories give different molecular orientation ratio values for different film thicknesses of the same material. Therefore, a new basic microwave theory was developed which enable the measurements to give the same values for different film thicknesses. A segment orientation ratio was proposed as a new definition of the molecular orientation ratio.

Hiroyuki Hamada, Kyoto Institute of Technology, Matsugasaki, Sakyo-ku, Kyoto:

High Performance Plastic Products with Simultaneous Composite Injection Molding

Simultaneous Composite Injection (SCI) molding is one of the categories of injection molding. The SCI molding machine has two injection units and two nozzles, and a mold has two sprues. Materials simultaneously flow into one common cavity through different gates. Basically two polymers meet each other in a molten state, which makes the interfacial strength quite high. Two color injection molding provides very weak interfacial strength because the two materials meet at the solid state. SCI molding can be applied to various articles, high strength joints of different materials, improvement of weldline, the sandwich injection molding and the two-layered injection molding. The objective of this method is the combination of two materials having substantially different properties, white/black, hard/soft, expensive/cheap, high/low in corrosion resistance, flammability and dielectric strength.

Michinori Nishikawa, JSR Corporation, Tsukuba, Ibaraki:
Polymers for Liquid Crystal Alignment Produced by Polarized Ultraviolet-Light Exposure

Photo-alignment of liquid crystals (LC) produced by polarized ultra-violet light exposure is one of the most promising candidates to realize non-rubbing liquid crystal alignment. For the photo-alignment of LC, some polymers, such as poly(acrylate)s and polyimides, have been examined as alignment layers. The properties of photo-alignment of LC polymers, such as photo-sensitivity produced by UV exposure, anchoring energy, and pretilt angle with respect to the chemical structures of the polyimides were investigated.

Fumihiko Tanaka, Kyoto University, Yoshida, Sakyo-ku, Kyoto:
Theoretical Study of Association and Thermoreversible Gelation in Polymers

Recent theoretical studies of molecular association and thermoreversible gelation with multiple cross-link junctions have been applied to polymer solutions and mixtures. Paying special attention to the multiplicity and sequence length of the network junctions, phase diagrams with coexisting gelation and phase separation have been developed for local and global structures of the gel networks.

The conventional Eldridge-Ferry method was extended to allow for simultaneous evaluation of multiplicity and sequence length and compared with experiments. A transient network model describes the molecular motion and the rheological properties of thermoreversible gels. Nonlinear viscosity, complex modulus, stress relaxation and stress overshoot were calculated from the time development of the number of elastically effective chains.

Noboru Yanagida, Kazunori Shigemori, Takuji Kishimoto, Jun Hasegawa, and Masahiro Yamasaki, Zeon Corporation, Kawasaki-shi, Kanagawa:

Development and Commercialization of Polymerized Toner

Toners used in copiers and printers have long been known as one of typical hybrids of organic/inorganic materials. These toners of the size of about 10 μm particles are made from polymer resin binders with several pigments, including carbon black, surrounded by nano-meter-size super fine inorganic particles such as metal oxide. Spherical toners have been developed by suspension polymerization. These toners have many superior features to conventional pulverized toners such as: simpler production process, more narrow particle size distribution, higher flowability and transfer ratio, better quality of printing images and lower temperature fusing with encapsulated toner. These features allow printers to meet present requirements for not only high quality but also of environmentally friendly design. Since further higher resolutions and lower fusing temperature are required in the market, especially in color toners, these suspension polymerized toners will play a significant role in the future.

Takashi Yamamoto, Yoshihiro Uozu, Nobuhiko Toyoda, Yoshihiko Mishina, and Kazuyoshi Koike, Mitsubishi Rayon Co., Ohtake, Hiroshima:

Development of New Graded-Index Plastic Rod-Lenses and Their Linear Arrays

Rod-lens is a cylindrical lens, which has graded index distribution in the radial direction. There are extensive applications for the linear rod-lens arrays, such as facsimiles, image scanners, copy machines and LED printers etc. Only lenses made of glass are now on the market for rod-lens arrays. We have now developed a continuous production process for commercially available plastic rod-lens with high quality. The linear array of the rod-lenses has excellent optical performance applicable to the image sensor of facsimiles, copy machines, handy scanners and LED printers.

Kenji Urayama, Kyoto University, Gokashou, Uji, Kyoto:
Rubber Elasticity, Structure and the Dynamics of Guest Chains for End-Linked Polymer Networks

Physicochemical properties of end-linked polymer networks are important. Endlinking technique provides a well-characterized network in which the length of network chain and the functionality of cross-links are controlled when they are prepared. The following topics were described: characterization of rubber elasticity by means of

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general biaxial deformation experiments, preparation of highly extensible elastomer, dynamics of guest chain trapped in polymer network, and spatial higher-order structure in end-linked networks.

Akira Kawai, Nagaoka University of Technology, Nagaoka, Niigata: *Interaction Analysis by Using Atomic Force Microscope*

The understanding of the adhesion and cohesion properties is of crucial importance for the development not only of microelectronic devices but also of devices on the nanometer scale. By using AFM (atomic force microscope), quantitative analysis of the collapse property of microresist pattern ranging from 141 to 405 nm diameter has been demonstrated. By directly applying a load to the top corner of the resist pattern with a microcantilever tip, a resist dot pattern adhering on a substrate can easily be collapsed.

Koichi Kato, Kobe University, Nada-ku, Kobe: *Designing Collagen-based Artificial Extracellular Matrix: Structural Optimization and Functional Amelioration*

Recent advances in tissue engineering provide us with promising methodology for the therapy of damaged tissues. This technology relies upon critically important elements including biodegradable matrices, regenerative cells, and cell-regulating factors, all of which cooperate in regenerating new tissues. Currently, polylactide, polyglycolide, and their copolymers are most frequently used for preparing biodegradable scaffolds, however these polymers have only bio-inert surfaces as conventional hydrophobic polymers. A novel process for the creating of biodegradable matrices with bio-active surfaces with porous scaffolds were described.

Kohji Tashiro, Osaka University, Machikaneyama, Toyonaka, Osaka:

Present Situation and Future Prospect of Computational Polymer Science as Exemplified by Case Studies of Structure-Property Relationship

The present situation and future prospects of computational polymer science by computer simulation of structure property relationship of polymer crystals were discussed. The importance of reliable potential functions was emphasized: (1) The molecular dynamics simulation of the temperature dependence of structure and mechanical property of ortho-rhombic polyethylene crystals, (2) Molecular dynamics simulation of ferroelectric phase transitions of vinylidene fluoride-trifluoroethylene copolymers, and (3). Simulation of X-ray fiber diagrams of polymer crystals by using models created by a energy minimization method and quantitative comparison with the observed data.

The key address at the 50th Annual Meeting of SPSJ was presented by Professor Emeritus Hideki Shirakawa, Nobel Laureate in Chemistry, 2000. This is the second time in the history of Nobel Prizes in Chemistry that the Prize was presented to a Japanese scientist. The first Japanese that had been chosen was Professor Kenichi Fukui, who received the Nobel Prize in 1981.

Hideki Shirakawa, University of Tsukuba, Tsukuba, Japan: *A Study of Polyacetylene and the Nobel Prize in Chemistry*

Shirakawa was exploring the polymerization of acetylene which had first been investigated over 19 years earlier by Natta. He used as transition metal compound tetra-n-butyl titanate not the normally used titanium tetrachloride. Acetylene was passed over the quiescent solution. By accident, a thousand fold excess in the catalyst concentration was used and a beautiful silvery film was obtained. Shirakawa was at that time an instructor (jo-shu) at the Laboratory for Chemical Resources, at the Tokyo Institute of Technology. Alan MacDiarmid Professor of Chemistry at the University of Pennsylvania heard about this extraordinary result and invited Shirakawa to work with him in Philadelphia. Modifying polyacetylene by doping it with iodine vapor oxidized the polymer to form a highly conductive polymer film from the original polyacetylene, an insulator. Together with Alan Heeger, a physicist, they developed measuring techniques for the conductivity of the doped polymer. Finally, they came to a conclusion that it was possible to introduce conductivity in polymers on a broad scale and published their discoveries in 1977: "Synthesis of electrically conducting organic polymers: Halogen derivatives of polyacetylene $-(CH)_n$." in *The Journal of Chemical Communications*.

This surprising discovery showing how plastic can be made to conduct electric current has radically altered our view of plastics as a insulating material. Since then, the field has grown extensively and has also led to numerous ideas about new applications, for example, light emitting diodes, new color screens and batteries.

Hideki Shirakawa, Alan G. MacDiarmid, and Alan J. Heeger were awarded the 2000 Nobel Prize in Chemistry by the Royal Swedish Academy of Sciences for "The Discovery and Development of Conductive Polymers."

A meeting of such magnitude requires the support of a smoothly and efficiently run organization. The Society of Polymer Science, Japan is such an organization. The office of SPSJ not only organizes the Annual Meeting and the Annual Symposium but also interacts with its members. The executive committee interacts also



Registration

with national organizations of Japan and members of the executive committee serve on National Committees.

As mentioned above, The Annual Meeting was held at the Osaka International Convention Center. Some participants stayed at the Hotel, but most participants who were from neighboring large Cities (Kyoto, Kobe or even farther away—greater Osaka is the home of nearly 20 million people) went home and commuted by train or subway. It is not uncommon in Japan for people to commute up to 2 hours daily to meetings or even to work.

The Registration required an undertaking of monumental dimensions. But, as usual, many hands from local organizations were prepared to help the members of the office of SPSJ. This provides experience for students and young scientists.

Annual Meetings and Symposia are the sites of a number of events. For example the meeting of the Editorial Board of Polymer Journal, the English Journal published by the Society took place—SPSJ also publishes some Journals in Japanese. Several committee meetings are also held at the Annual Meeting.

It is customary that about 10-15 foreign guests attend the annual meetings of SPSJ. Some are closely associated and/or cooperate with scientists of the Society. It is also customary that a luncheon is being held on this occasion which is attended by selected visitors and some past presidents of the society. This time the lunch-



Mikiharu Kamachi Takeo Saegusa Tisato Kajiyama



Akihiro Abe Yoshiko Imanishi



At the Banquet



Susumi Nakai

Yoshio Okamoto



Hitoshi Yamaoka

Junji Furukawa

eon participants include N.A. Platé (Moscow), O. Webster (Wilmington, DE), O. Vogl (Amherst, MA), T. Saegusa, A. Abe, Y. Imanishi, M. Kamachi, S. Nakahama, T. Kajiyama, and K. Shida.

One of the highlights of the Annual Meetings and Symposia is the presentation of Awards. There are Awards for students, industrial polymer chemists for young and also for established investiga-

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Masayuki Endo

Hiroshi Inoue

tors. The most important Awards are the International Distinguished Scientists Awards. This year there were 2 recipients: Nikolai A. Platé of Moscow, Russia) for his broad contributions to global polymer science and Owen Webster (Wilmington, DE, U.S.A.) for his discovery of Group Transfer Polymerization.

For exceptional service to the society, honorary memberships to SPSJ are bestowed on highly deserving persons, mostly past Presidents of the society. This year's recipients were Yukio Imanishi, President of the Society in 1993-1995 and the Nobel Laureate Hideki Shirakawa.

The "Banquet" is always held the night before the end of the

Annual Meeting or Annual Symposium and is attended by many participants of the meetings. We estimated that this dinner was attended by perhaps 500 people. It is in buffet style, and consists of Japanese (with chopsticks) and Western food (with knife and fork). For one of us (OV) it was an especially exiting event. Dozens of friends attended which allowed him the opportunity to see them again although sometimes only briefly to recollect experiences of many years ago. It was also the time to greet many young friends that have now taken the responsibility to create and establish the polymer science of the future.

It is also traditional during the banquet that one of the prominent senior member of the society proposes the toast "kampai". This year it was Professor Junji Furukawa, President of the Society in 1978/79. Now 89 years old, he is still a pillar of the tradition of the society.

As every year the Annual Meeting was a great success. It was nice to see how the young generation is taking over with competence and confidence.

For me (OV) it was a special celebration: 35 years since I first visited Japan at the IUPAC meeting in Japan. My visit was arranged by Junji Furukawa. It was 33 years ago when I attended the first time the Annual Symposium in Matsuyama, at Ehime University in the Fall of 1968. I have attended a number of Annual Meetings or Annual Symposia of SPSJ, several times as an invited speaker. I wish the Society and the Japanese polymer community continued success in the future.