IUPAC 32nd International Congress on Macromolecules "MACRO 88"

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Conference Report

IUPAC 32nd International Symposium on Macromolecules “MACRO 88”

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The IUPAC 32nd International Symposium on Macromolecules was held from August 1 to 6, 1988 at the Kyoto International Conference Hall, Takamatsu, Kyoto, Japan. The Symposium was organized by the Society of Polymer Science Japan under the chairmanship of Professor Takeo Sano of Kyoto University, Kyoto, Japan.

IUPAC International Symposia on Macromolecules have a long history. The first symposium was held in 1958 in Liege, Belgium, the most recent one in 1987, was held in Merseburg, GDR; the 33rd is planned for Montreal, Canada from July 8 to 13 in 1990.

One IUPAC Macromolecular Symposium was held previously in Japan in Tokyo/Kyoto in 1966, 22 years ago. It was the 14th IUPAC International Symposium on Macromolecules.

Kyoto is an excellent location for international meetings; it was the ancient imperial capital of Japan for more than 1,000 years until 1868 and is now a city of 1.5 million inhabitants. Kyoto has been and is still the center of the civilization of Japan with about 2,000 temples and shrines. Kyoto has produced and is the home of many art treasures and is considered the spiritual home of culture of all Japanes. Today Kyoto is a cultural and academic center with a number of universities and research institutions. It is also the center of both traditional and modern industries and is the site of many leading venture businesses.

The world famous Kyoto International Conference Hall was opened in 1966 and is among the leading international conference centers in the world.

MACRO 88 attracted over 1,000 participants from Japan and abroad. Nearly 500 participants came from 41 foreign countries. The IUPAC 32nd International Symposium for Macromolecules consisted of 9 plenary lectures, 22 invited and 53 session lectures. Over 500 contributed papers were presented in oral form and in over 200 poster presentations. The emphasis of the conference was on specialty polymers particularly high performance polymers and functional polymers including bio-related polymers, as it is believed that such polymeric materials play an essential role in the development of polymers for advanced technologies. In addition, the relation of IUPAC and polymer science was emphasized.

MACRO 88 EXPO was also held at the Event Hall in conjunction with MACRO 88; it was sponsored by the Society of Polymer Science, Japan. MACRO 88 EXPO was an exposition of advanced polymeric materials and scientific instruments and attracted over 50 exhibitors from the Japanese industry. In addition many if not all research groups in polymer science of universities and research institutions presented their image and the newest results of their work.

Kyoto and the favorable environment around MACRO 88 also was the basis of the first Council meeting of the recently
formed Pacific Polymer Federation where the first meeting in Maui, December 12-15, 1989 was established. Polymer Summit, Kyoto, a meeting place of representatives, polymer organizations and societies from 23 countries and 3 regions as well as the “IUPAC Forum” was also held during the IUPAC 32nd Symposium on Macromolecules under the leadership of Professor T. Saegusa, the chairman of the Macromolecular Division of IUPAC. In the forum activities of the division were introduced by T. Saegusa, activities of the commission on macromolecular nomenclature by P. Kratochvil (Czech.), and activities of the commission on polymer characterization and properties by M. Mandel (Netherlands). Discussions on the future activities of the division followed the presentations.

The Conference started in the evening of Monday, August 1, 1988 with an opening reception given by the Society of Polymer Science, Japan which was a traditional Japanese reception featuring beer and Suntory Whiskey with a variety of food. The young polymer chemists of Japan invited the conference participants to a beer party on Tuesday evening. Both events were held at the Kyoto International Conference Hall. On Wednesdays, the official banquet was held at the Kyoto Hotel. It was attended by over 500 participants.

A ladies program was arranged for the 63 accompanying guests from overseas which included visits to various historic monuments of Kyoto and also some of the interesting and traditional places of Kyoto. Various tours were also arranged in the surroundings of Kyoto.

The conference was opened by Professor Saegusa, the organizer of the symposium and chairman of IUPAC Macromolecular Division. The conference was also greeted by Professor T. Higashimura, the President of the Society of Polymer Science, Japan and Professor W. Heitz, the Vice President of the IUPAC Macromolecular Division. Dr. J. Kondo, the President of the Science Council of Japan extended his address celebrating the opening of the Symposium. The address of the Mayor of Kyoto, M. Inagawa, was given by Mr. Y. Okuno, the Deputy Mayor of the city.

In his opening plenary lecture, Professor W. J. Bailey of the University of Maryland and former president of the American Chemical Society presented his work on “Radical polymerization of cyclic compounds” where he described the polymerization of 2-vinylcyclohexanone and other cyclic compounds to biodegradable aliphatic polyesters. Some of them showed expansion of volume during the polymerization. The next plenary lecture was given by E. W. Fischer of the Federal
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Republic of Germany on the "Structure of homopolymers, block copolymers and polymer blends as revealed by neutron scattering." He presented a very excellent review of the now 15 year old new techniques to evaluate polymeric structures in solution and in the solid state. A most impressive lecture was given by Y. Ito chairman of the board of Toray Industries in Japan on the "Future prospects of polymer industry." He emphasized the fusion of polymer technologies with other advanced fields, which contributes to the pursuit of individual influence and realization of healthy life for older people.

The symposium's scientific activities were continued in lecture rooms of the Conference Hall by the presentation of invited lectures (45 min. each), session lectures (30 min.), oral communications (14 min.) and posters within the following 6 frameworks:

1. Polymerization chemistry
2. Synthesis of new polymers and polymer reactions
3. Structure and properties of polymers
4. High performance polymers
5. Functional polymers

In the first two sessions about 130 oral communications and about 50 posters were presented, demonstrating still growing activities in synthetic polymer chemistry.

Control of polymerization reaction permits us to control polymer structure. Along this way, living polymerizations via various processes have been developed in recent years. T. Higashimura (Japan) has established living cationic polymerization of vinyl ethers. The concept of "Stabilization of carbocation" by counterions or by additional weak bases was adopted for their living polymerization system. The wide scope of "Macromolecular design" via living carboxycationic polymerization of n-hexylbenzene was emphasized by J. P. Kennedy (U.S.A.) in his invited lecture. Organosilicon chemistry was emerged in "Living cationic ring-opening polymerization" using a sila-silane by D. Y. Sogah (U.S.A.).

S. Isoue (Japan) has proposed "Immortal polymerization" of epoxide with metalloporphirin, where the polymer with controlled molecular weight was obtained in the presence of alcohol as transfer agent. Highly isotactic and syndiotactic living polymerizations were achieved on methacrylates through anionic mechanism using t-BuMgBr by K. Katada (Japan), and t-BuLi/R-Al by T. Kitayama (Japan), respectively. T. Segusa presented a session lecture "Functional polymers on the basis of 2-oxazolinines," showing a wide variety of utilization including non-ionic surfactant. His group also developed a new process of ring-opening polymerization of vinylcyclopropanes by Ph(0) complex. Kinetic aspects of ring-opening polymerization were discussed by S. Penczek (Poland) and by H. Sekiguchi (France), focusing on "activated monomer mechanism." As for the coordination olefin polymerization by metal complex, the structural elucidation of active sites (K. Soga, Japan) and the development of new catalyst (H. Yangihara, Japan, M. Nakagawa, Japan) were reported. Metathesis polymerization of cyclic olefins was surveyed by H. Höcker (F. R. G.) on ring-chain equilibrium and by K. J. Ien (U.K.) on kinetics and rearrangement of tungstacarbide to tungsten-carbide monitored by 1H NMR. Preparations of high cis polyacetylene via coordination polymerization were reported by H. Shikata (Japan) using "liquid crystal method" and by Z. Shen (China) using rare-earth metals. The rare-earth catalysts were also effective for preparations of high cis poly(phenylacetylene) and epoxide polymers.

M. Kanaih (Japan) reported ESR observation of propagating radical of vinyl ethers, concluding the deviation from sp2 planar conformation of the radical center. Unexpectedly high reactivity of bulky dialkyl furanones was elucidated by B. Yamada (Japan) from the determination of kinetic parameters and ESR spin-trapping experiment. Alternating radical copolymerization of donor and acceptor monomers was discussed by V. P. Zuvov (U.S.S.R.). Formation of heterotactic alternating copolymer of styrene and methyl methacrylate was reported by Y. Gotod (Japan). D. J. T. Hill demonstrated the validity of pentultimate model of the copolymerization of styrene and acrylonitrile up to 90% conversion. J. C. Salamone (U.S.A.) reported, in his session lecture "Cationic/anionic monomers and polymers," the formation of alternating amphoteric copolymers by a charge transfer polymerization process, and demonstrated gel formation of an aqueous solution of the polymer under shear or simply by shaking it.

Stereochemistry of macromolecular chains was discussed by M. Farina (Italy) from a fundamental point of view, and by P. Fino (Switzerland) focusing on regio- and stereospecificity of chiral Ziegler-Natta catalysts. O. Vogl (U.S.A.) mentioned a method for the measurement of optical rotation in suspension, which provides a tool for characterizing rigid helical polymers. Asymmetric polymerization mechanism of methacrylates giving helical polymers and their utilization to chromatographic separation of racemates were presented by Y. Okamoto (Japan).

A session lecture by R. Chih (Japan), "NMR characterization of amorphous piezoelectric polymers" showed the importance of NMR spectroscopy in polymer characterization. Two-dimensional NMR and solid-state high resolution NMR became more and more familiar to polymer scientists as evidenced by so many papers presented at this conference. Among the NMR accessible nuclei, deuterium NMR was proved by T. Samui (U.S.A.) to be effective in the studies of ordered structure and solvation motions in polymer chains. "Dynamic-infrared linear dichroism and two-dimensional infrared analysis of polymer" reported by I. Noda
(U.S.A.) showed new possibility of IR spectroscopy for the
detection of specific interaction and connectivity among
functional groups. Scanning tunneling microscopy was also
newly introduced in microcharacterization of polymers on
metal surfaces by T. Nishi (Japan).

As demonstrated by about 60 oral presentations and about
80 posters in the high performance polymers, the synthesis
of new chemical structure of polymer or the processing of
the conventional plastics for high modulus and high strength
polymers is very attractive for polymer scientists. In this sec-
tion recent developments in high temperature polymers, high
modulus and high strength polymers, polymer liquid crys-
tals, polymer alloys and polymer composites, elastomers and new
polymer processing were presented. H. Cherdron (F.R.G.)
surveyed in his invited lecture “New high performance poly-
mers,” the general overview and development of high per-
formance polymers, e.g., polyaryles, polyether ketones,
polybenzimidazole, fluorinated polymides and graphited
polymers. The invited lecture of T. D. Goldman (U.S.A.)
“Thermoplastic glutarimide polymer” was focused on the
polymer characterization and reaction mechanism with an
alloying agent. Studies on the high temperature polymers
were reported from various research groups for polyamic
acid, epoxide, fluoro polymers, polyheteroarylene, poly-
(amine-sulfone) and poly(amine-ketone). The polymer modi-
fication for application of composite materials was given by
M. Takayanagi (Japan) in his invited lecture “Modification of
wholly aromatic polyamides for high performance ma-
terials,” using sodium methylsulfanyl carbamation which reacts
with poly(p-phenylene terephthalamide) (PPTA) to give a
homogeneously solution of PPTA polymer in DMSO.

New and low cost thermotropic liquid crystalline poly-
mers were reported by W. J. Jackson, Jr. (U.S.A.) in his in-
vited lecture “New high performance plastics of liquid

crystalline polyesters (LCP)” concerning about the thermal,
rheological and molding plastic properties of LCP’s prepared
from dimethyl trans-4,4'-stilbenedicarboxylate and aliphatic
glycol. Wholly aromatic polyester (Ekonol type) was de-
scribed by H. Sugimoto (Japan) in his session lecture. He has
tried to produce many copolyesters composed of p-hydroxy
benzoic acid, aromatic dicarboxylic acids and aromatic
diphenols to improve the processability of LCP. J. P. Quentin
(France), X. Y. Wang (China), and H.-J. Park (Korea) pre-
sented the LCP behaviors of new aromatic polyesters and
copolyesters.

On the other hand, many attempts to obtain high modulus
and high-strength fiber for the conventional flexible poly-
mers, e.g., ultrahigh molecular weight polyethylene
(UHMWPE), poly(vinyl alcohol) (PVA), poly(ethylene
terephthalate) (PET), and polyacrylonitrile (PAN) were pre-
vented. UHMWPE has been commercialized as a high-strength
fiber in Japan, U.S.A. and European countries. The invited
lecture of A. J. Pennings (Netherlands) “Structure develop-
ment in high-strength polyethylene fibers” summarized the
preparation and properties of high-strength polyethylene
fiber. The high-modulus and high-strength UHMWPE was pre-
pared by the melt-draw orientation method (Y. Akana,
Japan), by super-drawing of UHMWPE reactor powder (T.
Kanamoto, Japan), by biaxial drawing of dried gel fiber of
UHMWPE (Y. Sakai, Japan), by elongation of UHMWPE gels
(K. Koyama, Japan), and by PE fiber reinforced composite
(N. A. J. M. van Arkel, Netherlands). The other approaches
for flexible polymer to gain the high-modulus and high-
strength were carried out by P. Tucker (U.S.A.) on high-
speed spinning and characterization of spun PET fibers, by T.
Kunugi (Japan) on PVA fibers by the zone-annealing method,
and by W. Sweeney (U.S.A.) on the preparation extended
chain of PAN.
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About 100 oral communications and 80 posters were presented on functional polymers including polymers for optics and optoelectronics, for photo- and radiation-sensitive polymers, for electroactive polymers, for thin films, and for membranes and separation. The attention by participants on this section focused mainly on the conducting polymers, organic ferromagnetic polymers and non-linear optical (NLO) polymers. H. Shirakawa (Japan) discussed the high alignment of fibril morphology in cis-rich polyacetylene (PA) formed films in low-temperature semicrystalline liquid crystal. PA-iodide doping yielded a maximum conductivity of 1.6 x 10¹⁸ S/cm and electrical anisotropy of 6.9. M. Hirooka (Japan) discussed recent developments of polyarylenevinylene through precursor processes with improvements of stretching technique in his invited lecture "Highly conducting polymers via soluble precursors." The polymer gave the conductivity of 1.1 x 10¹⁸ S/cm. In his invited lecture "Molecular design of conjugated polymers for electrical and optical properties" G. Wegner (F.R.G.) presented the preparation and physical properties of various conducting polymers. Polydiacetylene, poly(alkylthiophene), poly(alklypyrrole), polyalkoxy substituted polythioalocyanogen(polyoxoamides) and alkyl-substituted polyarene are representative of present aspects of the conducting polymers. F. Garner (France) in his session lecture "Organic semiconducting polymers for electronic devices" discussed the field-effect type microelectrochemical transition and the semiconducting characteristics of polythiophene and its 3-substituted derivatives. Polymeric organic ferromagnet material was presented by the invited lecture of A. A. Orshinikov (USSR). He presented the two types of ferromagnetic polymers. One ferromagnetic polymer was obtained by the polymerization of an acetylene with a nitroxy radical substituent, and the other one was prepared by pyrrole decomposition of PAN. T. Sugino (Japan) has reexamined the polymerization of acetylene with a nitroxy radical substituent, and the USSR group's ferromagnetic behavior. The existence of truly organic ferromagnetic polymer was still obscure.

A tremendous interest in the electroactive properties of organic and polymeric materials grows the designed molecular architecture of new electronic and optical materials. S. K. Tripathy (U.S.A.) gave his invited lecture on molecular design of organic and polymeric materials for NLO. Polydiacetylene monolayers with appropriate side groups organized by the Langmuir-Blodgett (LB) technique may demonstrate a unique combination of cubic and quadratic NLO properties and their respective modulation. Preparation of novel polydiacetylene by topochromic solid state polymerization and their NLO properties were described by H. Nakashima in his session lecture. Another approach to obtain NLO polymers was reviewed by C. Noel (France) in her session lecture of LCP. Ferroelectric polymers were also interesting from the aspects of their application; polyvinylidene fluoride and their copolymers by A. J. Lorimer (U.S.A.), LC ferroelectric polymers by V. P. Shibaev (USSR), and J. Pfieker (Switzerland) reported the application of high-performance polymers to the photo-sensitive polymers in his session lecture "Photo-sensitive polymer resins." M. Irie (Japan) prepared photosensitive polymers using the rod-shaped acrylamide gels. The gels showed reversible bending upon ultraviolet irradiation in an electric field. The preparations of thin-film using various methods including plasma and electrochemical polymerization and LB technique were reported from several groups. Y. Imai (Japan) has developed a novel method to prepare mono- and multilayer films of polypyrroles through LB technique. N. Ogata (Japan) has succeeded in the synthesis of aromatic condensation polymers, poly(1,4-phenylene-5,5(6,6)-phenylene-2,2'-dicyan) from monomers spread at the air/water interface and in the preparation of their built-up film.

A session of Bio-related Polymers was organized to include "Natural Polymers and Their Modification," "Polymers of Biological Interest," and "Polymers of Medical Interest." L. Timco, Jr. (U.S.A.) showed sophisticated application of 2D NMR spectroscopy to the structural elucidation of DNA and RNA in his invited lecture, "Nucleic acid structures from A to Z." "Local helix-coil transition in DNA" or the stability of the double helix was discussed by A. Wada (Japan) with emphasis on its genetic implication. Understanding of the interaction between polymeric materials and living organs is essential in the biomedical use of polymers. Discussion on this subject was made by P. Ferruti (Italy) and N. A. Plate (USSR) on de-heparinization, and by H. J. Lee (Korea) on implantable devices. Artificial membranes and its bioimmitic functions were discussed by T. Kunitake (Japan) and R. Schwuyer (Switzerland). Kunitake demonstrated that synthetic chiral bilayer membranes grew to helical superstructure. Schwuyer found new modes of specific interactions of flexible, water-soluble neuropeptides with artificial lipid membranes, and proposed "Membrane compartments theory" to describe the molecular mechanism of receptor selection. Activities shown in this session impressed on many participants the importance of the fusion of biochemistry and polymer science.

The conference was concluded with the closing ceremony followed by another traditional beer party at the Conference Hall on Saturday noon. "IUPAC Macromolecules Kyoto," the proceedings of this symposium, which contains the full papers of plenary, invited and session lectures, will be published at the end of March, 1989 by Blackwell Scientific Publications, Ltd., as announced in the closing ceremony. The next "MACRO" will be organized from July 8 to 13, 1990 in Montreal, as announced by Professor R. E. Pud'homme in an address of invitation during the closing ceremony.

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