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IUPAC Symposium on Ring Opening Polymerization '92, Warsaw, Poland, July 7-11, 1992

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Conference Report

IUPAC Symposium on Ring Opening Polymerization '92



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The Symposium on Ring Opening Polymerization '92 was held in Warsaw from July 7-11, 1992. It was sponsored by the International Union of Pure and Applied Chemistry (IUPAC) and was organized by Zbigniew Jedlinski of the Institute of Polymer Chemistry, Polish Academy of Sciences. The Symposium was also sponsored by the State Committee of Scientific Research, by the Polish Academy of Sciences, by the Polish Chemical Society, by the Committee of Chemistry-Polish Academy of Science, by the Silesian Technical University-Gliwice, by the Janina and Zbigniew Porczynski Foundation-Warsaw and by Janssen Chimica-Belgium. About 100

participants attended the Symposium on Ring Opening Polymerization '92, 40% of whom were from the host country, Poland; 15 countries were represented. The symposium was held at the Conference Center of the Ministry of Defense in Warsaw. The selection and the availability of the meeting place was interesting because this was the location where, in previous years, numerous high level meetings of the former Warsaw Pact were held. The meeting organizers were, as has been traditional for Symposia on Ring Opening Polymerizations, assisted by an International Scientific Committee and by a Local Organizing Committee.

This Symposium was the seventh meeting on Ring Opening Polymerization. The first meeting was held in 1975 in Jablonna, a beautiful castle near Warsaw in Poland, with Professor Stanislaw Penczek as the chairman. It is difficult to actually pinpoint the exact number of Ring Opening Symposia because at least two of the meetings, although officially designated as Ring Opening Symposia, were held in conjunction with National Meetings of the American Chemical Society.

The meeting was opened by the Chairman of the meeting, Zbigniew Jedlinski, the Director of the Institute of Polymer Chemistry, Polish Academy of Sciences, Zabrze, Poland. The Symposium consisted of 19 keynote lectures, and 15 shorter papers; 21 communications were presented in poster form.

The meeting was addressed by Professor Aleksander Gieysztor, the President of the Polish Academy of Sciences, by D. Jan K.



Zbigniew Jedlinski, Symposium Chairman



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Frackowiak, the Deputy Minister, State Committee of Scientific Research, by Professor Janusz Jurczak, the Deputy Head of the Division of Mathematics, Physics and Chemistry of the Polish Academy of Sciences and by Professor Zbigniew Galus, the President of the Polish Chemical Society. IUPAC was represented by Professor Pierre Sigwalt. Mr. Coleman J. Nee, the Councilor for environmental, scientific and technological affairs of the U.S. Embassy in Warsaw, also addressed the meeting.

The keynote lectures were opened with a talk by Philippe Teyssie of Liege, Belgium. His talk was entitled "Metal Alkoxides: A Performance Tool for Macromolecular Engineering by Coordination Ring Opening Polymerization." The structural versatility of simple metal alcoholates has given them an outstanding position as soluble polymerization initiators, particularly the ring-opening of heterocyclic monomers. They still rank first, in the form of multinuclear oxobimetallic alkoxides, for the polymerization of oxiranes to high-molecular weight polyethers, displaying a controllable broad range of tacticity. Most lactones are polymerized by a perfectly living process with simple aluminum alkoxides. Strict conditions in terms of temperature, nature of the average number of available OR groups and monomer reactivity are necessary. Aluminum may be replaced by other metals in the initiating system. Careful application of these conditions allowed the development of a sophisticated system of molecular engineering, yielding many new polymers such as di- and tri-block copolymers. Many potentialities also arose from the versatility of monomer structures; isocyanates yielded polyamides-1 and aliphatic cyclic anhydrides could be converted in a "living" manner into biocompatible degradable polyanhydrides.

"Ring-Opening Oligomerization Reactions Using Aluminum Complexes of Schiff's Bases as Initiators" was presented by A. Le Borgne, V. Vincens and N. Spassky of the Université Pierre et Marie Curie in Paris, France. N. Spassky described the preparation of bifunctional telechelics with well defined structures which were obtained by oligomerization of heterocyclic monomers using specific metal Schiff's bases complexes as initiators with aluminum central atoms. Such initiators were found to allow the control of molecular weight, the direction of the ring-opening and the functionality of the final products. Initiators were prepared by reacting Schiff's bases (derived from salicylaldehyde) and diethylaluminum chloride. A series of oxiranes substituted with methyl, ethyl, methoxymethyl and chloromethyl groups were polymerized with achiral and chiral

initiators. Chiral Schiff's base aluminum complexes showed a stereoselectivity leading to preferential oligomerization of one enantiomer from a racemic monomer mixture. The highest stereoselectivity ($k_s/k_r = 1.3$) was observed with methyl oxirane, while epichlorohydrin appeared to be the most reactive but least specific monomer. β -Butyrolactone was also oligomerized with a stereoselectivity comparable to that of methyl oxirane.

"Anionic Polymerization of Lactide" was presented by Hans R. Kricheldorf, Caroline Boettcher and Ingrid Kreiser-Saunders of the Institute of Technical and Macromolecular Chemistry, Hamburg, Germany. Dr. Kricheldorf studied the anionic polymerization of L-lactide in solution. Anions of acids with the P_K values below 12 did not initiate the polymerization, whereas alkoxides and *n*-butyllithium were found to be efficient initiators. The effect of the chain growth of the polymer initiated by the alkoxide ions was established by endgroup analyses. Various initiators were prepared *in situ* from primary or secondary alcohols and potassium butoxide. With oligo- or polyethyleneglycols as initiators di- or tri-block copolymers were prepared. The usefulness of hematin and chlorophyllin as initiators was also demonstrated.

Eric J. Goethals of the University of Ghent in Ghent, Belgium presented his work on "Branched Polymers by Cationic Ring-Opening Polymerization." Branched polymers were synthesized by copolymerization of a "normal" monomer with a small amount of trifunctional comonomer. Coupling reactions between an endgroup-reactive linear polymer with another polymer having complementary reactive functional groups in or on its backbone, and copolymerization of macromonomers were used to prepare crosslinked polymers. The polymerizations described in this paper were carried out in the presence of a "monofunctional" molecule that is a comonomer as well as a transfer agent. In the polymerization of cyclic acetals, two monofunctional monomers were studied: glycidol and glycerol formal. The second method was based on the occurrence of an irreversible termination reaction in some cationic ring-opening polymerizations. This termination reaction took place when the active species of the polymerization reacted with a hetero-atom of the polymer backbone with the formation of a stable non-cyclic onium ion. This is the case for thietane, the four-membered cyclic



Discussions

sulfide. A-B type block copolymers of THF and thietane, obtained by sequential monomer addition, spontaneously formed branched polymers where the branches were located in one of the two polymer segments.

"Mechanism of Formation of Cyclic Species in Ring-Opening Polymerization of Cyclodimethylsiloxanes" was presented by P. Sigwalt, M. Masure, M. Moreau of the Université Pierre et Marie Curie, Paris, France. P. Sigwalt pointed out that a general feature of the cationic polymerization of all cyclodimethylsiloxanes is the

formation of various cyclic products together with linear high polymer. The types of cyclics as well as their rate of formation varied considerably and depended on the number of D units (CH_3SiO units) in the cyclic monomers. The initiation by trifluoromethanesulfonic (triflic) acid in methylene chloride solution has been particularly carefully studied. With D_4 , D_5 , D_6 and D_8 , for which the polymerization rate increased with the size of the rings, all types of cyclics D_x were formed in amounts decreasing with their size ($\text{D}_2 < \text{D}_3 < \text{D}_4 < \text{D}_5$). Water was found to play a very important role on the polymerization rates. It was concluded that while the polymerization of D_4 by triflic acid can be compared to the polymerization of D_4 with other initiators, the polymerization of D_5 by triflic acid had in its propagation steps activated triflic acid components. D_5 seemed to have in the propagation the monomer activated by the higher hydrates of the acid components. The formation of the D_5 cyclics apparently resulted from the continuous formation of linear oligomeric silanol esters.

S. Sylvie Boileau of the College de France, Paris, France, presented her work on "Ring-Opening Polymerization of Cyclic Organosilicon Compounds." Kinetic studies of the anionic polymerization of cyclosiloxanes with two methyl groups per silicon atom, D_4 , have been carried out with the cryptate $\text{Li}^+ \text{C}(\text{CH}_3)_3^-$ (211) as the counterion. In this particular case, no aggregates were formed and the cryptated ion pairs are the only type of active species. It was therefore possible to study the propagation and the cyclic by-products formation. Anionic polymerization of these series of hexaalkylcyclotrisiloxanes where R was ethyl, n-propyl, n-butyl and n-hexyl was studied. Because of the slow reaction rates, the propagation and redistribution could be followed directly by NMR spectroscopy.

"The Synthesis of Polysiloxanes with Electron-Donating Groups by Anionic Ring Opening Polymerization" was presented by Jan Chojnowski and K. Rozga of the Center of Molecular and Macromolecular Studies of the Polish Academy of Sciences, in Lodz, Poland. It was shown that a considerable amount of interest has arisen for polysiloxanes bearing electron-donating groups pendent to the polymer chain. These polymers combine the unusual flexibility of the siloxane chain with the ability of the polymers to form ionic and covalent complexes with various electron acceptors. They are now being exploited as materials for various purposes including chromatography, catalysis, polymer reagents, conducting polymers, adhesives and others. The introduction of electron donating groups onto polysiloxane side chains also led to useful modifications of their physical properties, such as their solubility, compatibility and their rheological behavior. The anionic ring opening polymerization of cyclic siloxanes was used as a route for the preparation of electron donating polymers. The polymers were prepared by anionic polymerization. High yields of polymers with

relatively narrow molecular weight distributions were obtained in kinetically controlled processes. The monomers have only one electron-donating group in the cycle of the six-membered ring and consequently the ratio of dimethylsiloxane units to electron donating groups in the polymers was 2 to 1. The transformation of various functional groups on polysiloxanes obtained in this anionic polymerization was demonstrated.

"Ring-Opening Polymerization of Strained Cyclobutanes as a New Route Towards Well Defined Polysilylenes" was presented by M. Cypryk, J. Chrusciel, E. Fossum and K. Matyjaszewski of Carnegie Mellon University, Pittsburgh, PA. K. Matyjaszewski presented their work on the chemistry of preparation and polymerization of 1,2,3,4-tetramethyl-1,2,3,4-tetraphenylcyclobutanes, which is one of the few known polymerizable cyclobutanes. The compound was prepared by dearylation of octaphenylcyclobutane with triflic acid and subsequent displacement of triflate by methylmagnesium bromide. In this way angular strain of the four-membered ring was preserved and four bulky phenyl groups were replaced by four smaller methyl groups. The cyclic compound could be polymerized to high molecular weight polysilylene using anionic initiators such as n-butyllithium or silylpotassium. The high reactivity of the growing silyl anions led to side reactions which resulted in poor control of the molecular weight and polydispersity. The (anionic) polymerization and its selectivity could be moderated and improved by various additives, such as crown ethers, cryptands, silyl cuprates, lithium halides, that could act as activating and deactivating agents.

Hartwig Hoecker of the Technical University-Aachen, Aachen, Germany described the "Ring-Opening Polymerization and Copolymerization of Cyclic Carbonates with a Variety of Initiating Systems." The ring-opening polymerization of cyclic monomers has had a long tradition. More recently, under the pressure of identifying recyclable materials, polymers that are potentially capable of ring-forming depolymerization have been studied extensively. As one example, the anionic ring-opening polymerization and random copolymerization of six-membered cyclic carbonates initiated by Li, Zn, Al and Sn alkyls or alcoholates were investigated. The alcoholate type active species formed in this system are able to initiate the ring opening polymerization of lactones which is accompanied by transesterification processes. On the other hand, monofunctional and bifunctional alcoholates of hydroxy-terminated polyethers or living polystyrene could be used as initiators for the



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anionic ring-opening polymerization of cyclic carbonates to produce AB- and ABA-block copolymers. The use of several other initiators was discussed for both the polymerization and depolymerization reaction.

Shiro Kobayashi of Tohoku University, Sendai, Japan discussed "Ring-Opening-Closing Alternating Copolymerization." He has developed a novel concept for a new type of copolymerization which involves ring-opening polymerization and cyclo-polymerization. The proper combination of a cyclic monomer A and a non-cyclic monomer B produced a copolymer whose structure has a ring-opened unit from cyclic monomer A and a ring-closed unit from monomer B in an alternating manner (ring-opening closing alternating copolymerization). For monomers A, five-, six- and seven-membered cyclic phosphorus compounds were used. For monomer B, muconic acid, aliphatic and aromatic dialdehydes and (meth) acrylic acid anhydrides and amides were found to undergo this reaction, which takes place without an added catalyst. This type of polymerization is believed to proceed via zwitterion intermediates.



Warsaw Mermaid, Symbol of Warsaw

"Ionic Polymerization of 1,2-Epoxy-3-Nitropropane" was presented by Emile Franta, F. Lagarde, S. Brugger and L. Reibel of the Institute Charles Sadron, Strasbourg, France. Emile Franta pointed out that 1,2-epoxy-3-nitropropane was studied in order to prepare end-dihydroxylated polymers. 1,2-Epoxy-3-nitropropane is not very stable and undergoes very readily isomerization to allyl alcohol. It was found that anionic polymerization was not suitable for this polymerization and isomerization occurred. Cationic polymerization yielded low molecular weight oligomers and cyclic oligomers. It was finally concluded that only linear oligomers 1,2-Epoxy-3-nitropropane could be obtained.

"Some Linear and Branched Macromolecules by Ring-Opening Polymerization" was described by Rolf C. Shul of the University of Mainz, Mainz, Germany. Ring-opening polymerization of macrocyclic etheracetals are of special interest for the preparation of polymers with functional groups, for example those with carbon-carbon double bonds. The polymerization of oxazolines, substituted in 2- and/or 4-position gave linear block copolymers composed of methacrylate blocks and oxazoline blocks. After hydrolysis, copolymers with ampholytic blocks were obtained. A new initiating system for the polymerization of oxazoline using chloroformates was developed using tri-functional initiators which gave 3 star polymers.

Stanislaw Penczek of the Center of Molecular and Macromolecular Studies, Lodz, Poland described his work on "Bioanalogous Poly(Alkylene Phosphates) by Ring-Opening Polymerization and by Ring-Opening Polyaddition." Methods using both anionic and cationic ring-opening polymerization were used to prepare bioanalogous polymer, mimicking the chains of nucleic acids and teichoic acids. In addition, polyaddition of diepoxides to acids of phosphorus, particularly the polyaddition of phosphoric acid and phosphoric acid to diepoxybutane, leading to poly (erythritol phosphate) showed them to be close analogs to native teichoic acids. It was recently found that certain silyl esters of phosphoric acid to epoxides could be used for the preparation of models of teichoic acids.

"Synthesis of Degradable Copolymers by Ring-Opening Polymerization" by Ann-Christine Albertsson, Anders Lofgren and Maria Sjoeling of the Royal Institute of Technology, Stockholm, Sweden was presented by Professor Albertsson. Degradable materials with applications in medicine are an area of polymer science of constantly growing importance. The materials are biocompatible, non-toxic and exhibit a wide variety of properties. Copolymerization was found to be a very efficient tool in the design of polymers with varying properties such as degradation rate or mechanical strength. Statistical and block copolymers were synthesized in bulk from 1,5-dioxepan-2-one, L- or D, L-dilactide, adipic anhydride, caprolactone and trimethylenecarbonate with stannous-2-ethylhexanoate as the initiator. Block copolymers were made in solution, initiated by aluminumisopropoxide under strictly anhydrous conditions. Properties like glass transition temperature, crystallinity, degradation rate and elasticity were determined. The polymers were modified by changing monomer compositions and polymerization techniques.

Robert W. Lenz of the University of Massachusetts, Amherst, MA described the "Coordination Polymerization of β -Butyrolactone and Related Monomers with Aluminosilane Catalysts." The paper was coauthored by Anthony J. Pajerski and Richard Peres. Aluminosilanes were found to initiate the stereoregular polymerization of racemic β -substituted- β -propiolactones. The polymers contain two different types of polymers: a relatively low molecular weight, atactic polyester and a high molecular weight, substantially isotactic polyester. The latter seems to be a stereoblock copolymer while the former is a random copolymer. Other polymers investigated were those from β -Butyrolactone, benzyl- β -malolactonate and β -pentyl-



Palace of Wilanow

β -propiolactone. Some of the polymers were prepared in high optical purity.

"Novel Chemistry of Lactone Polymerization" was presented by Zbigniew Jedlinski, Institute of Polymer Chemistry, Polish Academy of Sciences, Zabrze, Poland. He stated that research in anionic polymerization of lactones and lactides continues at an extraordinary pace. Many recent papers describe new chemistry of ring-opening polymerization and ring-opening reactions. It has become more and more of interest to study the initiation reactions; in fact, the original initiator or the initiator fragment was found to be absent in the polymer. Elimination, or electron transfer reactions, occurred sometimes at the initiation step. Typical examples of non-classical chemistry have been found in β -propiolactone and δ -valerolactones polymerizations. Proton abstraction occurred frequently. Electron transfer caused the generation of monomer intermediates such as enolates or carbanions; they are then capable of propagating the polymerization reaction. Some examples of this novel chemistry of lactones were discussed. They include unusual organic chemistry for carbon-carbon bond scission in β -propiolactones induced by alkali metal supramolecular complexes.

Robert E. Prud'homme, University of Laval, Canada presented his work on "Molecular Conformation of Optically Active Polyesters and Their Stereocomplexes." Solid-state NMR of polymers of α -methyl- α -ethyl- β -propiolactone, which differed in tacticity and thermal history, was studied. Several polymorphs of the polymers were found depending on the history of the polymer preparation. Of greatest interest was a stereocomplex which crystallizes in a different lattice from previous polymer structures. Another type of polymer was found to have been formed in atactic samples and solution cast isotactic films.

The group of F. Schue of the University of Montpellier in Montpellier, France, which includes G. Clarotti, J. Sledz, K.E. Geckeler, W. Goepel and A. Orsetti, described the "Possibilities Offered by Plasma Modification and Polymerization to Enhance the Bio- and Hemocompatibility of Polyester Membranes." The plasma polymerization of gases present in a low temperature plasma is a "clean" technique for biomedical material processing. This paper described the possibilities of preparing low cost membranes required for bio- and hemocompatibility. Depositions from a plasma consisting of a mixture of ethylene oxide and perfluorohexane on films of polyhydroxybutyrate were described.

"High-Speed Living Ring-Opening Polymerization with Novel Catalyst System Based on Metalloporphyrins" was presented by Shohei Inoue of the University of Tokyo, Tokyo, Japan. Metalloporphyrins, particularly those of aluminum, are known to be excellent initiators for living ring-opening polymerization of epoxides and lactones, and in special cases, of the addition polymerization of acrylic monomers. These polymerizations are anionic polymerizations and involve the attack of the growing species of the metalloporphyrin, as the nucleophile, to the monomer as the electrophile. The reactivity of the monomer could be enhanced by the addition of a Lewis acid. It accommodated and activated the monomer by coordination. It was found that a direct interaction between the growing species and the Lewis acid, which itself is an electrophile, must not occur in order to maintain the polymerization as a "living" polymerization. The principle of designing new catalyst systems is to select an appropriate Lewis acid that can coordinate and activate the monomer for nucleophilic attack by the growing species, but does not directly react with the latter. Organolauminum compounds with bulky groups such as a



Opening Mixer

Lewis acid of this nature have been found for the polymerization of epoxides, lactones and methacrylates. The compounds belong to the category of aluminum methyl compounds with two alkyl substituents of highly hindered phenols.

A number of short communications were presented at Ring Opening Polymerization '92, including the "Alternating Copolymer of 2,2-Dimethyltrimethylene Carbonate and ω -Caprolactam by Insertion of ω -Caprolactam into Poly (2,2-Dimethyltrimethylene Carbonate)" by B. Wrum, K. Keul and H. Hoecker of Germany.

2,2-Dimethyltrimethylene carbonate was polymerized with dibutylmagnesium or aluminum-tri-sec-butanol as the initiator. Insertion reactions were also performed with ω -caprolactam derivatives.

"Kinetics and Solid State Formation of the L-Lactide Bulk Polymerization" was presented by A.J. Nijenhuis, D.W. Grijpm and A.J. Pennings, University of Groningen of the Netherlands. The kinetics of the L-lactide bulk polymerization were studied using tin (II)-2-ethyl-hexanoate and zinc-bis(2,2-dimethyl-3-heptanedionato-0,0).

"Polymerization of ω -Caprolactone Initiated by Aluminum Dialkylaloxides" was discussed by Andrzej Duda of Lodz, Poland. The polymerization was carried out by dialkylaluminum alkoxide. The results were compared with those using trialkoxyaluminum and the Teyssie initiators.

Hilmi Amri and Alessandro Gandini of St. Martin d'Here France presented their work on "The Anionic Polymerization of: Furyloxirane." 2-Furyloxirane was found to respond to cationic or anionic initiation, but the latter gave polymer possessing a more regular structure.

"Living Stereospecific and Enantioasymmetric Polymerization of Propylene Sulfide" was presented by Philippe Dumas of Paris France. The initiation of propylene sulfide was carried out by bis(isopropyl-S-cysteinato)cadmium. The polymerization was found to be stereospecific and enantioasymmetric and was a living polymerization.

Zbigniew Florjanczyk presented the work on "Anionic Copolymerization of Sulfur Dioxide with Oxiranes." The work was coauthored with Dorota Raducha. Sulfur dioxide was found to undergo copolymerization with various oxiranes to form polysulfite. Quaternary ammonium salts, inorganic salts complexed by crown ethers, amines phosphines and other Lewis acid bases which easily form onium salts were found to be very efficient initiators. Linear polymerization competed with cyclization reactions leading to the

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formation of alkylene sulfites and macrocycles. The share of linear and cyclic products depended mainly on the kind of the oxirane, the initiator concentration and the reaction temperature.

"Cationic Epichlorohydrin" was discussed by M. Dreyfuss and Peter Dreyfuss of Central Michigan University. Epichlorohydrin could not only be polymerized by aluminium based coordinative catalysts but also by standard cationic initiators. "Cationic Polymerization of Glycidol" was presented by A. Dworak, Poland. He described the polymerization of glycidol with various cationic initiators among them boron trifluoride, its diethyl etherate and stannic chloride. T. Takata in cooperation with T. Ariga and T. Endo presented their work on "Selective Cationic Ring-Opening Polymerization of Cyclic Carbonate with Alkyl Halides." The cyclic carbonates have recently become of great importance for the preparation of aliphatic polycarbonates. It was found that cationic polymerization of cyclic carbonates with alkyl halides proceeded without any loss of carbon dioxide. Cationic polymerization of 1,3-dioxan-2-one and 5-butyl-1,3-dioxan-2-one with alkyl halides such as methyl iodide and benzyl bromide (20mol%) were carried out at 120°C in bulk or in solution.

"Organic-Inorganic Polymer Hybrids Between Silica Gel and Polyoxazoline" was presented by Y. Chujo, S. Kure, H. Matsuki and T. Saegusa of Kyoto, Japan. Organic-inorganic polymer hybrids having chemical bonds at the end of organic polymer segments were prepared using sol-gel procedures starting with polyoxazoline silane coupling agents.

Przemysław Kubisa described his work with T. Biedron entitled "Polymers Containing Stable Ionic End-Groups by Ring-Opening Polymerization." Polymers containing ionic groups as substituents along the chain, showed specific properties resulting from the formation of ionic aggregates. Much less studied were the polymers containing ionic groups, specifically at the chain's ends, primarily due to the limited availability of such polymers. Ion trapping methods were used for the preparation of phosphonium salt terminated polymer chains.

"Totally Biodegradable Thermoplastic Resin Blends Containing Polycaprolactone" was presented by M. Gnatowski in cooperation with A. Koutsandreas and T. Foster of New Westminster, Canada. Polymers prepared were 33-66% blends of polycaprolactone. Witold Kuran in cooperation with T. Listos of Warsaw, Poland described

"Novel Coordination Mechanism of Epoxide Ring-Opening Polymerizations." The mechanism proposed previously by the authors, of the propylene oxide homopropagation and copropagation with CO₂ in the presence of catalysts based on ZnEt₂ and protic compounds, has been supported by new evidence. They include studies on catalyst activity, polymer structure and end group analysis.

A number of posters were presented, which included the "Synthesis of Poly(β -Butyrolactone) Block Polymers via Anionic Polymerization Followed by Coupling with Alkyl dihalides" by Grazyna Adamus, Aleksander Czech, Marek Kowalczyk and Zbigniew Jedlinski; "The Synthesis of Hydrolysable Polymers Using Ring-Opening Polymerization" by Ann-Christine Albertsson, Anders Lofgren, Ronnie Palmgren and Maria Sjoeling; the "Block-Copolymerization of Lactide and ω -Caprolactone in the Presence of Li-Tertbutoxide" by Maciej Bero, Janusz Kasperczyk and Grazyna Adamus; the "Copolymerization of L, L-Lactide with ω -Caprolactone in the Presence of Initiators Containing Zinc and Aluminium" by Maciej Bero, Janusz Kasperczyk, and Grazyna Adamus; the "Addition of the Phosphoric Acid to Oxirane" by Tadeusz Biela, Ryszard Szymanski and Przemysław Kubisa; "Synthesis of Polysiloxanes in a Tubular Fixed-Bed Reactor by D. Cardinaud and J.M. Frances; "The Anomeric Effect Associated with the Silanol Group in the Chemistry of Polysiloxanes" by J. Chojnowski, M. Cypriak, K. Kazmierski, S. Rubinsztajn; and "Kinetics of Polymerization of Cyclotrisiloxane (D₃) Initiated by Trifluoroacetic Acid" by Marek Cypriak.

Also presented were: "Cationic Polymerization of Carbazoyl-Substituted Oxiranes" by Juozas Grazulevicius; "A New Stable System Containing Potassium Anions for the Polymerization of Oxiranes" by Z. Grobelny, A. Stolarzewicz, M. Sokoi, J. Grobelny and H. Janeczek. The "Polymerization of δ -Valerolactone Initiated with Potassium Naphthalenide" by Krystian Hennek, Marek Kowalczyk, Piotr Kurcok, Zbigniew Jedlinski, Anders Lofgren and Ann-Christine Albertsson; the "Synthesis of Poly(L-Lactide Block-Oxyethylene-Block-L-Lactone)s via Anionic Polymerization" by Henryk Janeczek, Piotr Kurcok, Wojciech Walach and Zbigniew Jedlinski; "Ring-Opening Copolymerization of Five-Membered Cyclic Carbonates and Epoxides" by W. Kuran, T. Listos and G. Rokicki; and the "Cationic Ring-Opening Polymerization of Fully Methylated Silicon Analogues of Dioxane" by J. Kurjata and J. Chojnowski.

Additional poster topics included "Pro-Mesogenic Polyether Telechelic Prepared by Cationic Ring-Opening Polymerization via Activated Monomer Mechanism" by J. Libiszowski and S. Penczek; "Free Radical Ring-Opening Polymerization of Unsaturated Cyclic Acetals" by J. Maslinska-Solich and A. Macionga; "Cyclic and Linear Carbonate Formation in Ring-Opening Reactions of 1,3-Dioxolan-2-ones with Oxiranes, Catalysed by Lewis Acids" by G. Rokicki, W. Kuran and N.S. Thinh; "2-(1,1,1-Tribromomethyl)-1,3-Oxazoline: A Novel Trifunctional Initiator for the Ring-Opening Polymerization of 2-Methyl-1, 3-oxazoline" by T. Bera and S. Sivaram; "Biodegradable Microspheres from ω -Caprolactone and Lactide as Protein Carriers" by Stanislaw Sosnowski, Teresa Basinska and Stanislaw Slomkowski; "Contribution of Covalent Propagation in Polymerizations with Ionic Covalent Interconversions" by R. Szymanski; "Ring-Opening Polyaddition of N,N'-Disubstituted Bisoxamaleimides with Diamines" by A.I. Volozhin, A.P. Solntsev, E.T. Krut'ko; and "Linear Epoxide-Amine Addition Polymers the Ring-Opening Reaction" by Hans-Heinrich Hoerhold and Joachim E. Klee.



Przemysław Kubisa, Witold Pradellak, Janusz Majnusz

At the end of the scientific program of the symposium, a short discussion was held on the "Present State of Art and Prospects of Ring-Opening Polymerizations." This discussion included the participation of Pierre Sigwalt, Shobei Inoue and Krzysztof Matyjaszewski.

In addition to the participation in the excellent scientific program, the participants aggregated in the evening of the first day of the symposium for the mixer to develop and further personal

acquaintances. On Thursday evening, the participants were invited by the organizers for a concert presented by the Warsaw Chamber Orchestra. The last official function of the meeting was the farewell luncheon on Friday.

The meeting was considered a success by all participants. Particular recognition should be given for the outstanding efforts of the chairman, Professor Zbigniew J. Jedliński of the Institute of Polymer Chemistry of the Polish Academy of Sciences in Zabrze, Poland, and the chairman of the local organizing committee, Dr. D. Sek of the same institute. The organizers selected the invited speakers with great foresight, carried out the organization of the conference, including the selection of the unusual conference site, with great skill, and provided the participants with a cordial and warm atmosphere, which is always the basis for good scientific and personal interactions. The organizers have to be congratulated for their successful effort.

In about three years, a ring-opening polymerization symposium is planned to be held in Sweden under the Chairmanship of Professor Ann-Christine Albertsson or in Germany under the Chairmanship of Professor Hartwig Höcker. The participants of Ring-Opening Polymerization '92 are looking forward to meeting again with new results, new ideas, and will be anxious to provide new impetus for the field of ionic polymerization especially ring-opening polymerization.



At the Dinner