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Centers of Polymer Research; Polymer Science in Osaka, Japan: Part II

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Centers of Polymer Research

Polymer Science in Osaka, Japan. Part II:

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In the last article on Polymer Science in Osaka, Part I, we described the activities in Polymer Science in the two campuses of Osaka University. The major part of the research and the teaching activities in academic institutions in polymer science in the Kansai district is carried out at the national universities of Osaka University and Kyoto University; municipal, prefectural and private universities play also an important role in polymer research in this part of Japan, although general and undergraduate teaching is a more predominant factor in polymer education.

This article is concerned with Universities involved in education in polymer science in the Kansai area: Osaka City University, Osaka Prefectural University, Kansai University, Kinki University, Osaka Institute of Technology, Kobe University and Himeji Institute of Technology.

OSAKA CITY UNIVERSITY

Osaka City University was first established in 1880 as the Osaka Commercial School. In 1928 the school acquired the status of a university and was called the Osaka University of Commerce; in 1949 it was reorganized and combined with three other colleges and named Osaka City University (Osaka Shiritsu Daigaku). At the same time, the Polytechnic Institute was founded which was in 1959 divided into two faculties; the Faculty of Science and the Faculty of Engineering. Osaka City University consists now of eight Faculties, three Research Institutes, a Botanical Garden, a University Hospital and a University Library.

Research in polymer science is now carried out in the Faculty of Engineering, but also in the Faculties of Science, Medicine and Science of Living, and the Research Institute for Atomic Energy.

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Takayuki Otsu

Department of Applied Chemistry, Faculty of Engineering—The research activities in polymer science in this department were initiated in the Polytechnic Institute in 1949 under direction of Professor Emeritus Minoru Imoto who retired from the University in 1971.

Professor Takayuki Otsu, his successor, is now conducting research in collaboration with Associate Professors Bunichiro Yamada, Tsuneyuki Sato, and Instructors Kiyoshi Endo and Shigeki Mori on the syntheses of new monomers, initiators and polymers. Details of the mechanism of radical polymerization, structure-reactivity relationship of monomers in radical polymerizations and monomer-isomerization polymerizations are being studied with particular emphasis in the following areas of research: synthesis and polymerization of sulfur-containing monomers, metal-containing initiators, homopolymerizations of 1,2-disubstituted ethylene monomers, and syntheses of head-to-head, graft and block polymers. The mechanisms of radical polymerization are being studied by the determination of absolute rate constants by the rotating sector method (B. Yamada), and intermediate radicals are being identified by ESR with the spin trapping technique (T. Sato). Presently, radical homo- or cyclopolymerizations of dialkyl fumarates or alkyl dimethacrylamide and block copolymerizations with living polymer radicals produced from acrylamide derivatives are also being studied. Isomerization polymerizations of internal olefins, especially of dialkyl maleate, with Ziegler-Natta catalysts are now under investigation (K. Endo).

Professor Masayoshi Kinoshita, in cooperation with Instructor Norio Kunieda, is carrying out investigations on the polymerization in organized monomer phases, and on the syntheses of functional polymers; polycondensation of active esters of amino acids and asymmetric syntheses in micellar systems, the syntheses of optically active polymers containing chiral sulfur atom, asymmetric oxidation using optically active polymeric reagents, and radical polymerization of vinyl monomers



Faculty of Engineering, Osaka City University

initiated by cyclodextrine-water-metal ion systems are also being investigated. Syntheses of polyphosphonamides are being carried out by Instructor Kiyoshi Yamachi. Template polycondensation of dicarboxylic acid active esters of nucleic acid bases with diamines in the presence of template polymers which contain nucleic acid bases as a side group is being investigated in cooperation with Instructor Yozo Miura. The studies of the inhibition of radical polymerization and the continued syntheses of polymeric stable radicals has led to the synthesis of a new stable free radical, sulfenaminyl.

Associate Professor Tadao Nakaya is working on the syntheses of liquid crystalline polymers. This work is now developing into the synthesis of lipid-analogous polymers, especially of methacryl polymers with aminoethyl phosphate groups which are connected to the main polymer chains with various length spacer groups.

Associate Professor Yoshiaki Ogo had been working on the high pressure polymerizations with Professor Tatsuya Imoto who retired in 1975. Dr. Ogo has continued and expanded this research on the effect of pressure on the absolute rate constants on the polymerization of styrene and methacrylic esters, but also on the analysis of pressure effects in termination reaction of these polymerizations.

Faculty of Engineering

Department of Mechanical Engineering—Professor Taichi Fujii is investigating fiber reinforced polymers and their mechanical behaviors by stress-strain analyses and studies of their fracture phenomena. Associate Professor Kiyoshi Mizuno is involved in the analysis of strength of composite structures (fiber reinforced polymer pipe and boxbeam) while Assistant Professor Takehito Fukuda is working on the properties of vibration of fiber reinforced polymer laminates. Another subject developed with Instructor Zenichiro Maekawa is an improvement of strength of composite materials by reliable design of glass fiber reinforced polyester laminates.

Faculty of Science

Department of Chemistry—Professor Nobuo Nakamura and Instructor Tetsushi Yamashita are studying the

syntheses of optically active polymers, and asymmetric reactions of amino acids using optically active polymers as the catalyst for polymerizations.

Associate Professor Taiichi Higuchi in cooperation with Instructor Makoto Fukuyo is working on the relationship between crystalline structure and the reactivity of monomers in solid state polymerization of cinnamic esters, N-vinylcarbazole, itaconic acid and N-vinylphthalimide. Dr. Higuchi and Instructor Ken Hirotsu are also carrying out, by x-ray diffraction analysis, the determination of the crystalline structure of the inclusion compound of cyclodextrine derivatives.

Research Institute for Atomic Energy

Professor Yuji Minoura, who died in the summer of 1979, had been conducting several research projects in polymer synthesis, especially of vinyl polymerization, syntheses of optically active polymers and syntheses of graft and block copolymers. Some of these studies are being continued by Instructor Masahide Yamaguchi, who is interested in the polymerization by asymmetric induction. Associate Professor Kyo Shiina is working on the syntheses of new polymers containing organometallic groups and is using these polymers as catalysts for chemical reactions.

OSAKA PREFECTURAL UNIVERSITY

The University of the Osaka Prefecture consists of four faculties; the faculties of Engineering, Agriculture, Economics, and Arts and Sciences; it was formed as a University of the new Japanese University system in 1949.

The Faculty of Engineering has ten departments, and the Department of Applied Chemistry nine research groups (Kozas), which include two groups involved in research in polymer science.

Department of Applied Chemistry—Professor Makoto Tanaka is carrying out research on reactions of methyl vinyl ketone and its derivatives, the synthesis of new polymers derived from methyl vinyl ketone, and photochemical reactions of high polymers which are derived from methyl vinyl ketone. He is now working with Associate Professor Masahiro Tsunooka, Assistant Professor Kaku Uehara and Instructors Minoru Sashio and Masamitsu Shirai on the synthesis of functional polymers, synthesis of photosensitive polymers, thermochromism of polymer-iodine complex membranes, photochemical and photoelectrical reactions of chlorophyll and photochemical reactions of dyes associated with polymer anions.

Professor Nobuhiko Kuroki is broadly interested in the fundamental aspect of the interaction of small molecules with macromolecules with special emphasis on dyes and interactions of biochemical interest. His research group, which includes Associate Professor Joichi Koga, Instructors Toru Takagishi and Mamoru Nango, work on the following problems: microenvironmental effect to acid-base equilibria in synthetic and biological polyelectrolytes, thermodynamics of the binding of polyelectrolytes with methyl orange derivatives in aqueous solutions, stereoselective hydrolysis of amino acid esters by polymer and micellar bifunctional catalysts

Centers of Polymer Research

with optically active groups.

KANSAI UNIVERSITY

Kansai University was founded in 1886 as Kansai Law School and has developed into one of the most prestigious private universities in Japan with a total student body of over twenty thousand. It has six faculties: the Faculties of Law, Letters, Economics, Commerce, Sociology, and Engineering; it also has a Graduate School with the respective faculties. The Faculty of Engineering was founded in 1958 to meet the urgent demand for education in science and technology, and has now ten departments. Polymer research in Kansai University is carried out at the Department of Applied Chemistry with three Professors, one Associate Professor, three Assistant Professors and two Instructors.

Department of Applied Chemistry—Professor Masayoshi Oiwa with Assistant Professor Akira Matsumoto are concerned with radical cyclopolymerization and gelation of unconjugated dienes, including diallylmonomers, allyl unsaturated carboxylates, and dimethacrylates. They are measuring solution properties of polymerization mixtures which simulate the gelation behaviors; synthesis and polymerization of polyfunctional oligomers or precursors of three-dimensional polymers are also investigated.

Assistant Professor Tatsuo Ouchi, a coworker of Research Professor Minoru Imoto, who retired from Kansai University in March, 1980, is concerned with radical polymerization. Vinyl monomers initiated by macromolecules such as cellulose, silk, nylon, polymeric phosphoric acid or polymeric sodium sulfate without any addition of common radical initiators are being investigated. More recently Dr. Ouchi started working on polymeric drugs and the photo-polymerization of heterocyclic compounds.

Professor Masaki Shimbo, in collaboration with Instructor Mitsukazu Ochi, is carrying out research on correlations between structures and mechanical properties of thermosetting epoxy resins. Adhesion, friction and fatigue of polymer, physical properties of polymer at lower temperatures, strain and internal stress caused by molding of thermosetting resins is being studied.

Professor Mizuho Sugihara and Assistant Professor Tadaahi Uragami are conducting research on the correlation between the functionality of polymers and their fine structure. Permeation mechanism through polymer membranes prepared by a variety of techniques from cellulose acetate, cellulose nitrate, and nylon 12 are being studied; these membranes are considered for ultrafiltration, reverse osmosis, or, using immobilized enzymes, for artificial kidney applications.

Associate Professor Kiyoka Yamamoto is investigating the polymerization of styrene derivatives such as dimethylstyrenes by radical or ionic mechanism. His recent research activity, in collaboration with Instructor Masakazu Tatsumi, is concerned with the elucidation of the mechanism of popcorn polymerization.

KINKI UNIVERSITY

Department of Applied Chemistry—Professor Toshihisa Maeshima with his research staff has been carrying out

investigations in polymer organic synthesis. Associate Professor Masakuni Yoshihara is responsible for the research on solvent effect and asymmetric induction in free radical polymerizations and stereochemically-controlled organic synthesis. Assistant Professor Natsuki Yamashita is working on the polymerization of acrolein and its derivatives. Assistant Professor Yoshio Matsubara is involved in the reaction and polymerization of nitrogen- or sulfur-containing cyclic compounds. Another research subject, developed with Associate Professor Kazuo Sugiyama, is the radical polymerization of vinyl monomers with tetrazene derivatives.

OSAKA INSTITUTE OF TECHNOLOGY

Department of Applied Chemistry—Professor Kunio Goto, with Associate Professor Hideki Fujiwara, is investigating mechanochemical reactions of polymers by ultrasonic irradiation; the group is also studying polymer blends of mechanochemically prepared block copolymers. With Instructors Takeo Iida and Kazushige Maruyama, research is also carried out on the stabilization of poly(vinyl chloride) and the synergisms in this stabilization.

Professors Ryoichi Fujishiro, Akihiro Kagemoto and Associate Professor Yoshihiro Baba are concerned with the interaction between a polymer and the solvent; the heats of dilution of many synthetic polymer solutions are determined with various types of microcalorimeters. Thermodynamic transitions in solvated homopolypeptides, proteins, and polynucleotides are being measured by calorimetric and spectral methods, in order to get quantitative informations of the ionic intra- and intermolecular bonding in these systems.

KOBE UNIVERSITY

The port city of Kobe is located about 30 km west from Osaka. The Faculty of Engineering of Kobe University, formerly Kobe Technical College, has had for more than sixty years its own history but in 1949 became one of the faculties of Kobe University. The Faculty of Engineering consists of eleven departments including the Department of Industrial Chemistry; two research groups are involved in research of polymer science.

Department of Industrial Chemistry—Professor Tsunetaka Matsumoto, a Vice President of the Society of High Polymers, Japan, is conducting research with Associate Professor Katsuhiko Nakamae and Instructor Masayoshi Okubo in the field of polymer synthesis and properties of polymers. They are concerned with the basic and applied research in polymer surface chemistry in three categories: polymer colloid chemistry; Mechanism of emulsion polymerization including emulsifier-free emulsion polymerization, syntheses of emulsion particles containing functional groups and the effect of functional groups on the properties of emulsion, the morphology of "confetti" type emulsion articles, temperature sensitive flocculant and emulsion type flocculants.

Organic-inorganic composite materials: Adhesion and cohesion between polymer and inorganic materials (cement, γ -Fe₂O₃, for magnetic tape, CaCO₃, etc.), wettabil-

ity and surface treatment of polymer.

Structure and physical properties of polymers: Preparation of fibers and films with functional groups, preparation and properties of copolymers of ethylene and vinyl alcohol as reverse osmosis film, and superstructures of polymers.

Professor Michio Ashida is carrying out research with Associate Professor Eiji Ikada and Instructor Yasukiyo Ueda. Among the projects of this group, the interaction between rubber and filler, dielectric relaxation of polymer, crystal formation and growth in polymer film, and the photo-degradation of polymer are being investigated.

HIMEJI INSTITUTE OF TECHNOLOGY

Department of Applied Chemistry—The Department of Applied Chemistry at Himeji Institute of Technology, which was established in Himeji City in 1949, has three research groups concerned with polymer chemistry.

Three professors, three associate professors and three instructors are active in this field.

Professor Yoshitake Yamamoto and his group, which includes Associate Professor Osamu Sangen and Instructor Hidehiko Nakano, are carrying out investigations on the synthesis and the physical properties of segmented polyester-ether thermoplastic elastomers. The group also investigated the catalytic action of synthetic functional polymers, especially enzyme model system modified with pyridoxal.

Professor Yasuhiko Ohno, in cooperation with Associate Professor Yukio Okada and Instructor Eisuke Tsukata, has studied the vinyl polymerization initiated by physiologically active substances especially the reaction mechanism of chrome complexes with collagen. Professor Masayoshi Hirota, Associate Professor Tadahiro Yamamoto and Instructor Tohei Yamamoto are studying solvent effects in radical polymerization.