Presenter: AOSHIMA Sadahito
Field: Others
Institution: Osaka University
Authors:
S. Aoshima, S. Kanaoka

Title:
Syntheses of Stimuli-Responsive Block Copolymers and Their Self-Association

Abstract:
Recent progress in living polymerization has encouraged us to design various types of amphiphilic copolymers, to examine their stimuli-induced self-association such as thermosensitive physical gelation. Thermosensitive physical gelation was demonstrated by using of diblock copolymer having a water-soluble polyalcohol segment and a thermally-responsive segment [poly(EOVE)]. When the aqueous solutions of the diblock copolymer were allowed to warm to the LCST for poly(EOVE), the sudden formation of physical gels was observed. The viscosity change was quite sensitive and reversible. The mechanism of the physical gelation was estimated as follows: (i) formation of micelles with well-controlled size and structure, (ii) subsequent close packing of the micelles [superlattice formation (bcc)]. On the basis of these results, different types of stimuli-induced sol-gel transition systems were designed.

Presenter: BEGINN Uwe
Field: Application
Institution: RWTH Aachen
Authors:
Uwe Beginn (1), Bernd Tartsch (2), Yvonne Noppeney (3)

Title:
Rational design of organogelators, and their use to create functional materials

Abstract:
Organogels are physical gels consisting of a solvent and a low molecular weight gelator. Gelation occurs on aggregation of the gelator molecules to networks made up from well defined elongated supramolecular structures. In this contribution a concept for the rational design of supramolecular organogelators is discussed, and demonstrated with gel forming alkoxybenzamides, alkoxysorbitoylbenzamides, and bis[alkoxybenzoyl]semicarbazides. The gelators can be used to generate functionalised organic porous materials with defined pores, membranes containing supramolecular ion transport channels, and mesoporous metal networks. The latter are expected to be applicable for catalysis, conductive coatings, and high-surface area electrodes for electrochemistry.

Presenter: DJABOUROV Madeleine
Field: Properties
Institution: Ecole de Physique et Chimie (ESPCI)
Authors:
Dominique Hellio and Madeleine Djabourov

Title:
Chemically and physically crosslinked gelatin gels

Abstract:
The relation between rheological properties and crosslinking mechanisms in gelatin gels is examined, either for the well known physical crosslinking (formation of triple helices between gelatin chains) or for chemical crosslinking, in presence of a bi-functional crosslinker and when both of them take place. In the latter case, gel elasticity is related to the superposition of the two mechanisms. The crosslinking reactions were followed by optical rotation and by microcalorimetry. Preliminary calibrations allow to quantify the rate of crosslinking by measurement of the enthalpy of reactions and/or conforamtional changes. The contribution of each type of crosslinks is put in evidence individually and in the mixed case. A possible modelling of the elasticity of the gels is discussed.

Presenter: FURUKAWA Hidemitsu
Field: Structure
Institution: Tokyo Univ. of Agriculture and Technology
Authors:
Hidemitsu Furukawa and Kazuyuki Horie

Title:
Characterization of both non-ergodic and ensemble-averaged properties of network structure in polymer gels with scanning

Abstract:
Dynamic light scattering is one of the most powerful tools for the nondestructive characterization of polymer gels. However, there is a serious problem about static inhomogeneities, which relates to the non-ergodic feature of the gels. It prevents us from studying the exact autocorrelation function of concentration fluctuation. We have developed a scanning microscopic light scattering system and derived general formulae for this system. By virtue of them, the nondestructive characterization of both local and ensemble-averaged properties can be performed. Its application to various polymer gels will be reported.

Presenter: GEISSLER Erik
Field: Structure
Institution: Universite J. Fourier de Grenoble
Authors:
E. Geissler(1), I. Morfin(1), A-M. Hecht(1), F. Horkay(2)

Title:
Light, small angle neutron and X-ray scattering from gels

Abstract:
In neutral polymer gels, the contributions to the scattering of radiation from osmotic and from static fluctuations can be distinguished at low values of the wave vector q by dynamic light scattering. At higher q, where the gel structure is revealed in small angle neutron scattering, these components can be resolved by neutron spin echo observations. The scattering properties of such gels can usually be described by two length scales.

Presenter: GONG Jian Ping
Field: Properties
Institution: Hokkaido University
Authors:
J. P. Gong, G. Kagata, T. Kurokawa, Y. Osada

Title:
Surface Friction of Polymer Gels

Abstract:
We have found that the frictional force of hydrogels shows specific dependencies on the normal load and the sliding velocity when slid against themselves or against solid substrates. Most importantly, the frictional coefficient of gels,which is defined as the ratio between the frictional force (shear stress) to the normal load (compressive stress), changes in a wide range and exhibits extremely low values (∼0.001) under certain experimental conditions. In order to describe the frictional behavior of a gel sliding on a solid surface, we have proposed a thermodynamic model from the viewpoint of polymer-solid interface interaction.The theoretical analysis predicted a high frictional force with a weak dependence on the normal compressive stress for attraction and a low frictional force with a strong dependence on normal compressive stress for repulsion and these predictions were in good agreement with the experimental observation.

Presenter: GOTTLIEB Moshe
Field: Properties
Institution: Ben Gurion University
Authors:
M. Gottlieb, I. Ginsburg, Y. Yagen, M. Karpassas

Title:
Effect of Molecular Architecture on Gelation of Methyl-Cellulose

Abstract:

Presenter: HANABUSA Kenji
Field: Material
Institution: Shinshu University
Authors:
K. Hanabusa, K. Ando, M. Suzuki, M. Kimura, H. Shirai

Title:
Gelation behavior of polysiloxanes having low molecular weight gelators as gelation-causing segment

Abstract:
Polymer type of gelators were prepared by introduction of low molecular weight gelators as gelation-causing segment into polysiloxanes. The obtained polysiloxanes could cause thermally-reversible physical gelation reflecting the introduced low molecular weight gelators as gelation-causing segment. The characteristic of polysiloxanes with gelation-causing segments is the formation of stable gels. Namely, the formed gels are so stable that they do not turn into crystals. Another characteristic of the polysiloxanes is the formation of transparent gels. Gelation behavior will be discussed from the standpoint of the kinds of polysiloxanes and the structure of gelation-causing segments.

Presenter: HU Zhibing
Field: Structure
Institution: North Texas University
Authors:
Zhibing Hu

Title:
Nano-fabrication of polymer gels

Abstract:
Our group has recently developed a new class of nanostructured hydrogels. The central idea to first synthesize monodispersed hydrogel nanoparticles, then self-assemble them into a 3D network, and eventually covalently bond them. The covalent bonding contributes to the structural stability, while self-assembly provides crystal structures that diffract light, resulting in a striking iridescence like opal. The work reviewed in this talk will include synthesizing mono-dispersed N-isopropylacrylamide nanoparticles with functional groups attached, characterizing self-assembling processes, describing the crosslinking chemistry, modeling elastic and optical properties associated with the nano-structures, and applying such nano-structured hydrogels for sensor applications.

Presenter: ITO Yoshihiro
Field: Application
Institution: Kanagawa Academy of Science and Technology
Authors:
Y. Ito

Title:
Micro- and Nano-Fabrication of Stimuli-Responsive Polymers

Abstract:
Microfabrication or nanofabrication of stimuli-responsive polymers is important for construction of smart chemical systems. We have devised some fabrication methods by using pH- and thermo-responsive polymers. One was photolithographic synthesis of micro-gels. Poly(acrylic acid) or poly(N-isopropylacrulyamide-co-acrylic acid) was chosen as a pH- or a thermo-responsive polymer, respectively, and the polymer was modified with azidophenyl groups to be a photo-reactive polymer. The modified polymer was cross-linked in the presence of photo-masks. The shapes of formed microgels spontaneously changed in response to stimulus. Another was carried out by grafting the pH or thermo-responsive polymer on nanoporous filter membranes. The conformational change of grafted polymer in response to stimulation induced size change of nanopores and resulted in regulation of substance permeation through the nanopores. These methods will be useful for construction of smart micro- or nano-devices in the future.

Presenter: ITO Kohzo
Field: Material
Institution: University of Tokyo
Authors:
K. Ito, Y. Okumura, Y. Domon, T. Kataoka

Title:
Sliding Gel Formed by Figure-of-Eight Crosslinks

Abstract:
We have formed a sliding gel with figure-of-eight crosslinks through polyrotaxane consisting of cyclodextrin and polyethylene glycol. The sliding gel showed a stress-strain curve quite different from conventional physical and chemical gels. The mechanical behavior was qualitatively explained by a three-chain model taking account of mobile crosslinkage. On the other hand, the small angle neutron scattering of the sliding gel exhibited the normal butterfly pattern in contrast to the abnormal butterfly pattern of the conventional chemical gel. This indicated that the sliding gel had no static inhomogeneity characterizing the chemical gel. In addition, the sliding mode of the closslinkage in the sliding gel was confirmed by the dynamic light scattering.

Presenter: Kataoka Kazunori
Field: Theory
Institution: The University of Tokyo
Authors:
Kazunori Kataoka

Title:
Totally Synthetic Polymer Gels Responding to External Glucose Concentration: Their Preparation and Application to On-Off

Abstract:
Recently, polymeric gels which change their physicochemical properties with external stimuli have been the subject of great interest because of their potential utility in diverse fields including controlled drug release, analytical and preparative separations, and sensor technologies. Yet, few examples are known of totally synthetic gels responding to chemical stimuli, i.e., a concentration change in particular molecules in the milieu, regardless of their wide applicability in the fields described above. More specifically, development of sugar-responsive gels may give great impetus to construct a self-regulating insulin-delivery system for the treatment of diabetes, a life-threatening disease showing an increased number of patients especially in developed countries. This presentation addresses the successful preparation of a totally synthetic gel undergoing an abrupt change in the swelling degree at a critical glucose concentration in aqueous medium. On-off regulation of insulin-release from this glucose-responsive gel will also be demonstrated. A basis of the system is the shift in the equilibrium between the uncharged and charged form of phenylboronic acid moieties in the amphiphilic polymer chain, *e.g.* PNIPAAm, thorough complex formation with glucose.

Presenter: KATO Takashi
Field: Material
Institution: The University of Tokyo
Authors:
T. Kato

Title:
Liquid Crystal Physical Gels: Self-Organized Structures and Electrooptical Properties

Abstract:
Here we show that anisotropic physical gels consisting of liquid crystals and low molecular weight gelators have great potentials as functional self-organized materials. For examples, nematic physical gels form microphase-separated structures where the fibrous aggregates of the gelators randomly and finely disperse in nematic liquid crystals. Such microphase-separated structures induce high light scattering by forming liquid crystal polydomains. The light scattering states are electrically switched to transparent states. For smectic and nematic physical gels, anisotropically oriented microphase-separated structures are formed. For example, oriented fibrous aggregates are obtained when the aggregation of the gelators occurs in aligned smectic A and chiral smectic C phases. The oriented fibers have effects on the ferroelectricity of the liquid crystals. The introduction of well-controlled microphase-separated structures into liquid crystals is one of the versatile approaches for developing novel functional materials.

Presenter: KHOKHLOV Alexei
Field: Theory
Institution: Moscow State University
Authors:
A.Khokhlov

Title:
Nanostructured Composites Based on Polyelectrolyte Gels

Abstract:
The structure of polyelectrolyte gels with incorporated clay platelets and rigid rods was studied both theoretically and experimentally. The emerging nanostructures were described and explained. Also, inhomogeneous gels containing voids were studied as a possible soft medium containing the regoins exhibiting properties of microreactors.

Presenter: KOIZUMI Satoshi
Field: Structure
Institution: Japan Atomic Energy Research Institute
Authors:
S. Koizumi

Title:
Gel-like Aspect of Polymer Mixture with Dynamical Asymmetry Studied by Small-Angle Scattering

Abstract:
We focus on polymer mixtures with ¥textit{dynamical asymmetry enhanced by temperature}, i.e, polystyrene (PS) and poly (vinyl methylether) (PVME). The large difference of glass transition temperatures Tgin the PS/PVME mixture, induces a large difference of mobilities as temperature decreasesto an intermediate region between the two Tg's. Therefore, we expect to observe "dynamical asymmetry enhanced by temperature". The intermediate temperature region is, at the same time, a so-called gel-like limit where the rheological relaxation is much slower than the concentration fluctuation relaxation. In this intermediate temperature region, for the first time, we reported two experimental results obtained by SANS; anomalous suppression of small-angle scattering at a quiescent state and shear-induced phase separation under shear. We interpret these findings in a theoretical framework of the dynamical coupling between stress and diffusion in the gel-like limit. Furthermore, we aim to review the dynamical coupling effect so far studied on the PS/PVME mixture by small-angle scattering. This dynamical coupling effect appears on small-angle scattering in different ways, depending on the balance between the relaxations of rheology and concentration fluctuations.

Presenter: LUTZ Pierre J.
Field:
Institution: Institute Charles Sadron
Authors:

Title:
Nanostructured Macromonomer Based Hydrogels Designed for Biomedical Applications

Abstract:

Presenter: MATSUKAWA Shingo
Field: Properties
Institution: Tokyo Univ. of Fisheries
Authors:
S. Matsukawa

Title:
Elucidation of Dynamics in Biopolymer Solutions by NMR Measurements

Abstract:
The exact calculation with no approximation of NMR relaxation times and diffusion coefficient measured by spin echo pulse sequence under chemical exchanging has been achieved varying the exchanging time, difference of resonance frequency and pulse separation, and compared with experimental results for biopolymer solutions. For solution of pullulan and solutions of gelain, gellan and carrageenans with random coil at high temperature, the fractional average of T2 for water and polymer chains is observed. For the solutions of gelain, gellan and carrageenans with ordered polymer chain at low temperature, the observed T2 becomes small and increases with decreasing temperature indicating the increase of the exchanging time.

Presenter: MATSUZAWA Yasuo
Field: Application
Institution: Ciba Vision Corporation
Authors:
Yasuo Matsuzawa and Juergen Vogt

Title:
SILICONE HYDROGELS AS CONTINUOUS & EXTENDED WEAR CONTACT LENS MATERIAL

Abstract:
High oxygen permeability is a prerequisite for contact lenses intended for extended wear, specifically for continuous day and night wear over several days and weeks. The oxygen permeability of ordinary hydrogels is limited to its water content, which cannot satisfy the oxygen permeability requirement for the extended wear application. Since the oxygen permeability of silicone elastomer is very high, silicone was formulated for contact lens application. However, due to hydrophobic surface and extreme surface tackiness, their tendency to adhere to the cornea became a serious drawback, which limited its practical application. A silicone hydrogel was then developed to circumvent this problem. This silicone hydrogel fulfilling the oxygen permeability requirement for continuous wear and having good water and ion transport characteristics contains two phases; one is the silicone phase, which is designed for the oxygen transport and another one is the hydrogel phase, which is for water transport including ions. Despite of the hydrogel incorporation to silicone, the silicone phase dominates the surface characteristics of the silicone hydrogel lens. Thus, the silicone hydrogel cannot be used without surface modification. The surface modification of the silicone hydrogel for continuous and extended wear is achieved by a plasma polymer coating. The performance of contact lenses made from silicone hydrogel is discussed in conjunction with the structure of the silicone hydrogel and its unique surface properties.

Presenter: MIYATA Takashi
Field: Application
Institution: Kansai University
Authors:
T. Miyata(1,2), N. Asami(1), M. Jige(1), T. Uragami(1)

Title:
Preparation of Biomolecule-Responsive Bioconjugate Gels Using Biomolecular Interactions as Reversible Cross-linkings

Abstract:
In this study, we prepared novel stimuli-responsive gels that undergo swelling changes in response to specific biomolecules, using biomolecular interactions such as antigen-antibody bindings and saccharide-lectin interaction. Bioconjugate gels having antigen-antibody bindings at cross-linking points underwent reversible swelling changes in response to a specific antigen due to complex disssociation and association between antigen and antibody. Glycoprotein-responsive gels were prepared by biomolecular imprinting using antigen and lectin as legands for a print glycoprotein. The fascinating properties of these biomolecule-responsive gels suggest that they have many future opportunities as intelligent materials in biochemical and biomedical fields.

Presenter: NAGASAKI Yukio
Field: Material
Institution: Tokyo University of Science
Authors:
Yukio Nagasaki

Title:
Stimuli-sensitive polymer gels that stiffen upon swelling

Abstract:
New silicon-containing polycation, poly(silamine), was found to show globule – rod transition in a minute change in an environmental condition such as pH and temperature. Its crosslinking hydrogel showed stiffness transition along with the volume transition. For example, poly(silamine) xerogel is elastic material, the shear modulus of which was ca. 30 kPa. On the contrary, its hydrogel became hard, though it contains water more than 60 %. Actually, the shear modulus of the swallen gel was ca. 400 kPa. It is striking contrast to other stimuli-sensitive gels investigated so far, which become soft when it swell. Such a gel having and unique mechanical property may open a new field as functionality materials.

Presenter: OKANO Teruo
Field: Application
Institution: Tokyo Women's Medical University
Authors:
Teruo Okano

Title:
Intelligent surfaces for Switching Attachment and Detachment of Cells

Abstract:
We have tried to construct a novel co-culture having layered tissue structure. For that, we have utilized temperature-responsive culture dishes. These surfaces show hydrophobic similar to tissue culture polystyrene dishes at 37˚C, but reversibly to hydrophilic and release cultured cells on them without the need for trypsin or EDTA. Dynamic hydration/dehydration change of poly(N-isopropyl acrylamide) on the surface affect detachment rate of cells and cell sheets due to architecture of the polymer. All the confluent cell s were harvested as a single contiguous cell sheet from the temperature-responsive culture dishes and readily reattached to other surfaces. We have called the novel system utilizing the cell and cell-sheet manipulation “cell sheet engineering” .

Presenter: OKUZAKI Hidenori
Field: Properties
Institution: University of Yamanashi
Authors:
H. Okuzaki, T. Takahashi

Title:
Humido-Responsive Conducting Polymer Gel Actuators

Abstract:
A combination of electrical and hygroscopic nature of conducting polymers provides an insight into the development of a new class of electro-driven actuators or artificial muscle systems that work in ambient air. We have found that polypyrrole films undergo quick and intensive motion in response to the reversible sorption and desorption
of water vapor. Furthermore, the film generates contractile stress of
6MPa under dc 2V, nearly 20 times that of skeletal muscle and for orders of magnitude larger than its own weight.

Presenter: ONUKI Akira
Field: Theory
Institution: Kyoto University
Authors:
Onuki Akira

Title:
Phase Transition and Phase Ordering in Gels

Abstract:
I will talk on theory and simulation of phase transition dynamics in gels. Important ingredients are nonlinear elasticity, electrostatic interaction, and heterogeneities in the network.

Presenter: OSADA Yoshihito
Field:
Institution: Hokkaido U.
Authors:

Title:
Intelligent Gels-An Approach to Artificial Muscles-

Abstract:

Presenter: POTEMKIN Igor
Field: Structure
Institution: Moscow State University
Authors:
I.I. Potemkin, R.E. Limberger, A.R. Khokhlov

Title:
Physical gelation and microstructure formation in solutions of associating polyelectrolytes

Abstract:
We have shown that the physical gel formation in dilute solutions of associating polyelectrolytes can be preseded by microstructuring of the solution at smaller polymer concentrations.Stabilization of spherical and cylindrical optimum-size clusters in the solution was predicted. The optimum clusters are formed as a result of competition between attraction of associating groups (stickers) and repulsion of the chains caused by their uncompensated charges and by translational entropy of counter ions. We have studied the dependence of physical gelation on the number of associating groups. Unusual effect of coalescence of optimum clusters (or single chains) and gel formation at the decrease of the number of stickers per chain was predicted. This so-called anomalous gelation has polyelectrolyte nature and is determined by the presence of mobile counter ions.

Presenter: RABIN Yitzhak
Field: Theory
Institution: Bar-Ilan University
Authors:
Y. Rabin (1) and S.V. Panyukov

Title:
Modeling phase separation and scattering from polyelectrolyte gels

Abstract:
We discuss the thermodynamics of micro and macro phase separation in weakly charged gels in poor solvent. We study the monomer density fluctuations in the gel and derive expressions for the scattering profiles.The effects of solvent quality, degree of crosslinking and of degree of ionization, and of the concentration of salt both in the state of preparation and in the final state of observation are considered.

Presenter: SHIBAYAMA Mitsuhiro
Field: Structure
Institution: University of Tokyo
Authors:
M. Shibayama, K. Isono, S. Okabe, and M. Nagao

Title:
Effects of Cross-linking on Critical Dynamics of Polymer Gels

Abstract:
Dynamic light scattering (DLS) as well as small-angle neutron scattering (SANS) studies have been carried out on temperature sensitive polymeric systems consisting of poly(N-isopropylacrylamide) (PNIPAM) aqueous solutions and gels in order to elucidate the effect of cross-linking on pressure-induced and temperature-induced phase transitions. It was found that noticeable difference in critical dynamics was detected by DLS. Spinodal and bimodal lines were constructed in the temperature-pressure plane on the basis of SANS data, which indicate an upper consolute pressure around 50 MPa. Critical exponents will be discussed in the presentation.

Presenter: SIEGEL Ronald
Field:
Institution: Unversity of Minnesota
Authors:
Ronald Siegel

Title:
Exploitation of Special Hydrogel Behaviors in Novel Drug Delivery Devices

Abstract:
We discuss results concerning two specific behaviors of hydrogels in the design of novel drug delivery devices. In the first case, a first-order phase transition, with hysteresis, in the characteristic relating glucose permeability to pH in poly(n-isopropylacrylamide-co-methacrylic acid) gels is exploited, in the presence of glucose oxidase, to produce a self-oscillating drug delivery system which, in the presence of a constant level of glucose, provides rhythmic, pulsing delivery of hormones. In the second case, binding of glucose to hydrogels containing phenylboronic acid (PBA) sidechains is shown to either swell or shrink the gels, due to increase in charge and crosslinking, respectively. Incorporating these PBA-based gels into micromechanical systems (MEMS) provides a basis for valves which can turn on and off the flow of insulin, according to ambient glucose level.

Presenter: TAKEOKA Yukikazu
Field: Material
Institution: Yokohama National University
Authors:
Y. TAKEOKA(1), M. WATANABE(2)

Title:
Tuning Structural Color Changes of Porous Thermo-sensitive Gels Through Quantitative Adjustment of The Cross-linker in Pre-gel

Abstract:
"Smart" porous gels with different optical behaviors were synthesized by quantitative adjustment of the cross-linker in pre-gel solutions. A periodically ordered interconnecting porous structure could be created in the gels by using a closest-packing silica colloidal crystal as a template. The interconnecting porosity provides fast response to changes in temperature through the reversible swelling and shrinking of the gels, while the periodically ordered mesoscopic structure endows the porous gels with structural color, which can be tuned by simply changing the amount of the cross-linker in the pre-gel solutions.

Presenter: TANAKA Motohiko
Field: Theory
Institution: National Institute for Fusion Science
Authors:
Motohiko Tanaka(1), and A.Yu. Grosberg(2)

Title:
Charge inversion of a weakly charged macroion at room temperature

Abstract:
The charge inversion phenomenon is studied by molecular dynamics simulations, especially for a weakly charged macroion of spherical and rod shapes (like DNA) in room-temperature electrolyte solvent. Charge inversion requires two conditions for onset, namely, strong electrostatic interactions and the presence of multivalent counterions. It is found that monovalent salt enhances reversed mobility under electrophoresis when its ionic strength is small, while it screens and suppresses the phenomenon for large ionic strength. There is a threshold of surface charge density for charge inversion to occur. A rod-shaped macroion and charged polymers (polyelectrolyte) as counterions are advantageous to lower the threshold. The simulation results partly confirm experimental observations of charge inversion with DNA.

Presenter: ULANSKI Jacek
Field: Material
Institution: Technical University of Lodz
Authors:
A. Joachimiak, T. Halamus, P. Wojciechowski, J. Ulanski

Title:
HYDROGELS BASED ON LYOTROPIC PHASES OF CELLULOSE DERIVATIVE

Abstract:
The hydrogels were obtained by "in situ" photopolymerisation of acrylic acid in lyotropic liquid crystalline (LC) phase of (2-hydroxypropyl)cellulose in a mixture of water and acrylic acid. The photopolymerisation at room temperature yields hydrogels in which LC order is preserved. The LC hydrogels contain water, which originates from the lyotropic phase and they absorb more water after immersion in liquid water. The hydrogels were examined by means of differential scanning calorimetry coupled with thermo-optical measurements and by Raman spectroscopy. Special attention was paid to a role of Ca+2 ions. The investigations reveal profound influence of calcium ions on the polymer network and on structure of water filling the interstitial space in the polymer network of the LC hydrogels.

Presenter: URAYAMA Kenji
Field: Structure
Institution: Kyoto University
Authors:
K. Urayama(1), Y. Okuno(2), S. Kohjiya(2)

Title:
Volume Transition of Nematic Gels

Abstract:
We have experimentally found that the liquid crystalline networks swollen by liquid crystaliine solvents or isotropic solvents exhibit discontinuous volume change accompanying the nematic-isotropic transition of the gels. A mean field theory well describes the swelling and phase behavior observed.

Presenter: WATANABE Toshiyuki
Field: Application
Institution: Tokyo Univ. of Agriculture and Technology
Authors:
T. Watanabe(1), N. Kimura(2), Y. Lu(3), K. Totani(4), I. Harada(5), T. Akaike(6)

Title:
Stimulus-responsive micro-actuator for biomedical applications

Abstract:
Stimulus responsive hydrogel are of scientific and practical concern for their potential applications in the variety of fields. Microfabrication of hydrogel has attracted a growing interest. We demonstrated that micro cantilever fabricated by using two-photon initiated polymerization (TPIP) was deflected by ≒45 degree based on tautomerization of hydrogel under illumination of UV light. In addition, micro-ring or micro-post of hydrogel for tissue engineering was prepared by suing TPIP. In this presentation, we will discuss structure property relationship of initiator for TPIP of hydrogel. Micro-actuator of hydrogel for biomedical applications will be presented.

Presenter: WATANABE Masayoshi
Field: Material
Institution: Yokohama National University
Authors:
Masayoshi Watanabe

Title:
Ionic Liquids and Ion Gels - A New Class of Liquids and Polymer Gels-

Abstract:
Ionic liquids are room temperature molten salts and have received much attention as non-volatile, non-flammable, thermally stable, and electrically conducting liquids. In situ radical polymerization of common vinyl monomers in these ionic liquids was carried out, and compatible combinations of the ionic liquids and the resulting network polymers were explored. Completely compatible combinations afforded new polymer gels, which were named ‘ion gels’. Fast ion transport in the ion gels has been studied in detail. Furthermore, methodology to give ion/electron mixed conduction and proton conduction to the ionic liquids and ion gels has been pursued and the recent development is presented.

Presenter: WHITTAKER Andrew
Field:
Institution: The Unversity of Queensland
Authors:
Andrew Whittaker

Title:
Swelling of hydrogels studied by NMR imaging and spectroscopy

Abstract:
NMR imaging has been used to measure the concentration profiles during swelling in water of a diverse range of hydrophilic polymers. The behaviour characterised spans the full range of kinetic expressions proposed for swelling of polymers, namely from Fickian to classic Case II diffusion. A number of methods of analysis of the concentration profiles are discussed. For materials which undergo small volume changes (< 15% linear expansion), the profiles conform to those derived from Fick's laws of diffusion. At higher swelling ratios, achieved in copolymers containing more hydrophilic units, the diffusion coefficient becomes concentration dependent, and the functional form of this dependency depends on the copolymer content. In between these two extremes we are able to control rates of diffusion by varying the block size in copolymers. Finally the rate of diffusion of water in materials which swell to a much greater extent is limited by the mechanical properties of the xerogel and swollen hydrogel. The advantages of the MRI methods are highlighted in this presentation.

Presenter: WU Chi
Field: Structure
Institution: The Chinese University of Hong Kong
Authors:
Chi WU

Title:
Oringins of speckles and slow dynamics of polymer gels

Abstract:
The [2+2] photocycloaddtion of 7-acryloyloxy-4-methylcoumarin attached to the PMMA chain at the entangled points can transfer a semidilute solution to a speckle-free gel with some “extraordinary” dynamics. First, its normalized intermediate scattering function f(q,□) can fully relax to zero, indicating that the gel has no frozen-in static component. This further indicates that the normal intensity speckles of the light scattered by different parts of a polymer gel originate from large voids inside, not crosslinked chains (clusters). Second, f(q,□) consists of a fast and a slow non-diffusive relaxation during the sol-gel transition. For the fast mode, the crosslinking, temperature and swelling have nearly no effect on its decay time <□c>f as well as its related scattering intensity during the transition, confirming that it is related to the motions of the sub-chains (blobs) between two entangled (crosslinked) points. As the crosslinking proceeds, the slow relaxation becomes even slower and its related scattering intensity sharply increases. The existence of the slow relaxation reveals that the gel network has a large spatial density fluctuation, different from the fast density fluctuation of monomers inside each blob. In comparison with the initial semidilute solution, the scattering vector (q) dependence of <□c>f and <□c>s shows that the scaling exponent □f in 1/<□c>f ~ q□f increases from 2.0 to 2.4, but □s in 1/<□c>s ~ q□s decreases from 3.0 to 2.3 as the crosslinking proceeds. The increase of □f is due to more correlated motions of different blobs, while the decrease of □s can be related to the decrease of the static correlation length of the large spatial density fluctuation. We also find that increasing the temperature (not due to the chain contraction since chloroform remains a good solvent) or swelling the gel has an opposite effect on the relaxation and the scattering intensity, which support our conclusion obtained on the basis of the crosslinking results.

Presenter: YOSHIDA Ryo
Field: Application
Institution: The University of Tokyo
Authors:
R. Yoshida

Title:
Novel biomimetic self-oscillating gels and their application to MEMS

Abstract:
We report a novel biomimetic gel that undergoes autonomous swelling-deswelling oscillations without on-off switching of external stimuli, similar to heartbeat. The mechanical oscillation of gel was produced via oscillating chemical reaction, called the Belousov-Zhabotinsky (BZ) reaction. The self-oscillating behaviors of the gel were investigated in detail. By using the moving mask deep-X-ray lithography (LIGA), a ciliary motion actuator made of the gel has been demonstrated. The gel plate with micro projection array was fabricated by molding technique. The actuator may serve as a micro-conveyer to transport micro- or nano-particles on the surface.

Presenter: AKIYAMA Yoshikatsu
Field: Application
Institution: Japan Science and Technology Corporation
Authors:
Y. Akiyama(1), Y. Tsuda(2), M. Ebara(2), M. Yamato (3), A. Kikuchi (3), T. Okano (3)

Title:
Design of intelligent bio-nano interface for cell attachment and detachment surface

Abstract:
PIPAAm gel was grafted onto tissue culture poly-styrene dish (TCPS) by EB irradiation method. Bovine aortic endothelial cells (BAECs) were cultured onto two different content of PIPAAm at 37-C. The dish containing low amount (ca 1.5mg/cm2) of the PIPAAm showed cell attachment property above LCST and detachment below LCST. On the other hand, in the case of the dish with high (ca 3.0mg/cm2) content of the PIPAAm, the cells did not attach the dish above LCST. Thickness of the gels is estimated to be ca 20 (low) and ca 60 nm, respectively. This different property is derived from the different dynamics of the PIPAAm gel by temperature change.

Presenter: AOKI Yusuke
Field: Structure
Institution: Kyoto institute of technology
Authors:
1)Yusuke. Aoki, 1)Tomohisa. Norisuye, and 1)Qui. Tran-Cong-Miyata, 2)Shigeki. Nomura and 2)Toshiya.Sugimoto

Title:
Dynamic Light Scattering Studies on Gelation Process for Sol-Gel derived Polymer Hybrids.

Abstract:
2)Frontier Technology Institute, Sekisui Chemical Co., Ltd.

Presenter: AOKI Takashi
Field: Structure
Institution: Kyoto Institute of Technology
Authors:
T. Aoki

Title:
Thermo-Sensitivity of An Optically Active Hydrogel

Abstract:
The author successfully synthesized an optically active polymer which showed transition behavior in water like as temperature-induced ‹protein denaturations‹. The optically active poly(N-(L)-(1-hydroxymethyl)propyl- methacrylamide) (P(L-HMPMA)) is a water-soluble polymer which shows a lower critical solution temperature at approximately 30 ¸C. The corresponding hydrogel showed similar hydration-dehydration behavior in response to temperature changes. This optically active polymer for the hydrogel results in structure formation, e.g., a regular secondary structure, which may be produced by a specific side-chain orientation. It can be noted that P(L-HMPMA) is a novel chiral macromolecule which helps to grasp the nature of higher ordered structures of biopolymers and to artificially build sites of molecular recognition and catalytic functions.

Presenter: CHOI Hak Soo
Field: Structure
Institution: Japan Advanced Institute of Science and
Authors:
Hak Soo CHOI, Tooru OOYA, Shintaro SASAKI and Nobuhiko YUI*

Title:
Control of Rapid Phase Transition Induced by Supramolecular Complexation of beta-Cyclodextrin-Conjugated Poly(epsilon-lysine)

Abstract:
beta-Cyclodextrin conjugated poly(epsilon-lysine) was synthesized and used as a polymeric host for inclusion complexation with 3-trimethylsilylpropionic acid (TPA). In this system, TPA included into hydrophobic cyclodextrin cavity acted as a physical cross-linker by cooperative hydrophobic and ionic interactions, which gave an important role in viscosity or transmittance changes near physiological conditions. The pronounced effect of pH on the change of viscosity was supported by rheological data. On the other hand, reversible phase transitions of the supramolecular assembling system occurred very rapidly in response to minute changes of temperature, which was verified by UV-vis measurements. The delicate control of critical aggregation temperature was accomplished by changing the degree of substitution as well as varying molar feed ratio or solution concentrations across their upper critical solution temperature.

Presenter: EBARA Mitsuhiro
Field: Application
Institution: Waseda University
Authors:
M. Ebara(1,3), M. Yamato(2,3), T. Aoyagi(2), A. Kikuchi(2,3), K. Sakai(1), T. Okano(2,3)

Title:
Novel thermo-sensitive nano-structure hydrogels for cell culture

Abstract:
In order to achieve precise control of cell adhesion, we developed a novel thermo-responsive nano-structures. Temperature-responsive co-polymers were covalently grafted onto culture dishes in nanometer thickness by electron beam irradiation. Then, peptides containing an intrinsic sequence for cell adhesion, Arg-Gly-Asp (RGD) were immobilized. The surfaces promoted cell adhesion and spreading at 37° C even in the absence of serum or cell adhesive protein supplement. On lowering temperature below 30 ° C, all the formerly spread cells were detached from the surfaces because the immobilized ligands were shielded by hydrated and expanded temperature-responsive polymer chains. These observations show that the nano-scale polymer structures could regulate cell-substrate affinities by responding culture temperature.

Presenter: EBATA Masaya
Field: Material
Institution: The University of Tokyo
Authors:
M.Ebata,R.Yoshida

Title:
Self-Beating Motion of Gels and Modulation of Oscillation Rhythm Synchronized with Organic Acid

Abstract:
Here we report a novel bio-mimetic polymer gel which exhibits autonomous self-beating motion like heartbeat and tunes its own beating rhythm to the environmental change. The gel possesses reaction pathway like TCA cycle to produce cyclic motion from the chemical energy of substrates. The change in substrate concentration varies the turnover rate of the reaction. As a result, the period and amplitude of swelling-deswelling oscillation are modulated. On-off regulation of self-beating in response to the concentration changes was also achieved. So far, many kinds of stimuli-responsive gels have been studied for the design of smart materials. In these systems, however, either swelling or deswelling of gels is driven by on-off switching of external stimuli such as temperature, pH, electric field, specific chemicals, etc. In contrast, this study is the first achievement of self-beating motion of gels as well as the modulation of self-beating rhythm. Applications such as intelligent beating-micropump are expected.

Presenter: FANG Yapeng
Field: Properties
Institution: Osaka City University
Authors:
Yapeng Fang,Katsuyoshi Nishinari

Title:
A Rigid Network of Schizophyllan Gel Formed by Addition of Borax

Abstract:
Schizophyllan forms a putty-like gel in the presence of borax which serves as a crosslinking agent. The gel network contains rigid Schizophyllan chains and dynamic crosslinks. The critical gelation point can not be determined by Winter-Chambon criterion, whereas the gelation process can be well described by the first order kinetics. The dependences of storage modulus and some kinetic parameters on schizophyllan concentration, borax content, temperature and salts were investigated. Moreover the putty-like structural properties were also studied.

Presenter: FUJII Tomoyuki
Field: Application
Institution: Niigata University of Pharmacy and Applied
Authors:
T. Fujii(1), T. Izumi(1), T. Yano(2), K. Nakamura(2), O. Miyawaki(2)

Title:
The sol-gel preparation of nanoporous silica membrane with controlled pore size

Abstract:
A thin nanoporous silica membrane was prepared by the two-step sol-gel method. First, silica membrane was formed onto the alumina support as an intermediate layer with fibrous silica colloid. Then, silica nanoparticles were deposited on the first layer of silica membrane surface again by the sol-gel method. The silica nanoparticle concentration in the coating solution for the second step modification was selected low enough to avoid the aggregates with the higher fractal dimention. The prepared membrane had a dense skin layer with a nanospace as interparticle void space.

Presenter: FURUHATA Yoshinori
Field: Application
Institution: University of Tokyo
Authors:
Y. Furuhata(1), Y. Ito(2), M. Nogawa(2), R. Yoshida(1)

Title:
Microfabrication of Self-Oscillating Gel by Photolithography

Abstract:
We have been studying the self-oscillating gel coupled with the oscillating reaction (the Belousov-Zhabotinsky reaction). The gel consists of the closslinked poly(N-isopropylacrylamide (NIPAAm)) to which ruthenium tris(2,2ı-bipyridine) (Ru(bpy)3), a catalyst for the Belousov-Zhabotinsky(BZ) reaction, is covalently bonded. In this study, the self-oscillating microgel has been prepared by photolithography. Two photolithographic methods; (1) using photoinitiator and (2) using the polymer with azidophenyl groups, were employed to control the gel structure. Several shapes of micrometer-sized gels with the same pattern as photomask were synthesized.

Presenter: GAO Shanjun
Field: Properties
Institution: Osaka City Universiy
Authors:
S.Gao(1),K.Nishinari(2)

Title:
Gelation of acetylated konjac glucomannan

Abstract:
Acetyl groups in konjac glucomannan (KGM) are known to confer the solubility to KGM, and the gelation of KGM on addition of alkali is induced by removal of acetyl groups. In a previous work (Huang et al., Biomacromol., 2002), acetylated KGM samples with different degree of acetylation (DA) were used but unfortunately molecular weight of KGM was reduced during acetylation. In the present study, heterogeneous acetylation of konjac glucomannan (KGM) was carried out in acetic anhydride by using trace pyridine as catalyst. By comparing the result from viscosity measurements in this case with that in the previous work where zinc chloride was used as catalyst, it is indicated that KGM was not sharply degraded during acetylation in this case and pyridine is a more moderate catalyst for the acetylation of KGM than zinc chloride. The role of acetyl groups in the gelation of KGM was examined by dynamic viscoelastic measurements.

Presenter: GOTOH Takehiko
Field: Application
Institution: Hiroshima University
Authors:
T. Gotoh, H. Okamoto, S. Sakohara

Title:
The Dewatering of Organic Slurry by Using Supported Thermosensitive Porous Gel

Abstract:
The chemical dewatering process by using thermosensitive gels, which absorb or release water molecules in response to temperature change have been noted in these days. In this research, N-isoprpylacrylamide (NIPAM) porous gels were applied for dewatering of rice rinsed water, which contained 10% of solid materials. The porous NIPAM gels were prepared utilizing a phase separation and were supported by stainless steel net to improve its mechanical strength. The water content of the dewatered cake could be decreased less than 50%, and the cake was easily removed from the gel surface. Furthermore, the dewatering process could be repeated without decreasing dewatering performance.

Presenter: HARA Yuhsuke
Field: Material
Institution: The University of Tokyo
Authors:
Yuhsuke Hara(1), Masayuki Nogawa(2), Takamasa Sasaki(1), Yoshihiro Ito(2), Ryo Yoshida(1)

Title:
Self-Oscillation of Polymer Chains with Rhythmical Soluble-Insoluble Changes

Abstract:
Self-oscillation of polymer chains in an aqueous solution has been achieved. The ruthenium catalyst for the Belousov-Zhabotinsky reaction was polymerized by using N-isopropylacrylamide and dissolved into the solution containing the BZ substrates. Periodical soluble-insoluble changes of the polymer chain were spontaneously induced by the BZ reaction. The conformational oscillations of the polymer were measured as the optical transmittance changes of the solution. This is the first report that rhythmical and reversible soluble-insoluble changes of polymer chains are realized under constant and homogeneous conditions. The transducing system from chemical energy of the BZ reaction to optical information ha been constructed.

Presenter: HAYASHI Hisato
Field: Application
Institution: Tokyo University of Science
Authors:
H. Hayashi(1), M. Iijima(2), Y. Nagasaki(3), K. Kataoka(4)

Title:
Stimuli Sensitive Nanogel Possessing Reactive PEG Tethered Chains On the Surface For High Performance Drug Carrier

Abstract:
Reactive PEGylated nanogel was synthesized via a dispersion copolymerization of Diethylaminoethyl methacrylate (EAMA) coupled with divinylbenzene in the presence of CH2=CH-Ph-CH2-PEG-COOH as stabilizer. KPS was used as initiater. At room temperature, the emulsion copolymerization proceeded smoothly up to 99.9 % conversion in 4 hours. The resulting nanogel possessed PEG-COOH tethered chains on the surface, which was confirmed by zeta-potential analysis. The carboxylic group at PEG free chain end can be converted to fluorescent probe via active ester method, which is expected to work as ligand install site. The volume transition was observed pH at around 7. Under suitable conditions, the size of nanogel changed from 60 nm (pH=7.4) to 240 (pH=4.0). Thus, the nanogels is of potential importance for applications in bio-related fields.

Presenter: HIRATANI Haruyuki
Field: Application
Institution: Menicon Co Ltd
Authors:
H. Hiratani(1), C. Alvarez-Lorenzo(2)

Title:
Timolol adsorption and release by molecular imprinted contact lens

Abstract:
The influence of the backbone components of a contact lens prepared by the molecular imprinting method on the achievement of a significant increase in drug loading capacity and on the controlled release properties was evaluated. The imprinted lenses were consisted of N,N-diethylacrylamide (DEAA), 2-hydroxyethylmethacrylate (HEMA), siloxyanylmethacrylate and N,N-dimethylacrylamide (SiMA-DMAA), or methylmethacrylate and DMAA (MMA-DMAA), to which fixed proportions of a functional monomer, methacrylic acid, and cross-linker. Timolol was used as the target molecules. Regarding timolol overall affinity, the lenses ranked in the order HEMA > SiMA-DMAA > MMA-DMAA > DEAA. The highest imprinting effect, i.e. the greatest relative increase in the affinity respect to non-imprinted systems, was obtained for the last two systems. The results obtained indicated that modulating the composition of the lenses it is possible to adapt drug loading capacity and release profiles of the lenses to the treatment requirements of different pathological processes.

Presenter: HIROTA Sadao
Field: Properties
Institution: Tokyo Denk University
Authors:
S. Hirota(1), Y. Takaoka (2), S. Ohi (3), Y. Sun (4), N. Duzgunes(5)

Title:
Determination of shape parameter of DNA-lipid complexe by viscometry

Abstract:
A simple technique for determining shape parameter of liposomes and DNA-lipid complexes using an automatic mini-capilllary viscometer is presented and its application to characterizations of DNA-lipid complexes is described. For DNA-lipid complexes, Einstein viscosity equation is extended to ellipsoids suspension, by introducing non-dimensional intrinsic viscosity which is related to axial ratio, a/b. Procedure for the viscosity measurements and calculation is shown by an example with plant DNA-distearyldimethylammonium chloride complex at charge ratio of 1:4 in which necessary amount of DNA is less than 0.5 miligram The proposed method can be applicable to determination of shape parameter of liposomes and bioactive polymer complex required for the quality control.

Presenter: HOSOYA Ken
Field: Structure
Institution: Kyoto Institute of Technology
Authors:
K. Hosoya, H. Aoki, M. Takeuchi, T. Ikegami, N. Tanaka, and T. Norisuye
Title:
Network Structures of the Polymers Derived From Methacrylate Type Cross-Linking Agents
Abstract:
Methacrylate type cross-linking agents have been frequently utilized for preparation of highly cross-linked polymers, but the detailed mechanism of the cross-linking has not been well elucidated so far. We applied a dynamic light scattering (DLS) method, high performance liquid chromatographic method (HPLC), and another methods including IR measurement for the elucidation of the cross-linking mechanism of several di-methacrylate monomers. We utilized ethylene glycol dimethacrylate (EDMA) and relatively hydrophobic 1,6-hexanediol dimethacrylate (HDMA), as well as glycerol dimethacrylate (GDMA) having a hydroxyl group in the middle (hydrophilic) to study the cross-linking mechanism. We found that the hydrophilic monomer (GDMA) and hydrophobic monomers (EDMA, HDMA) show a quite different gel growth in toluene from each other. The GDMA gel grows intermittently, while the EDMA or HDMA does continuously in a static system like in a test tube.

Presenter: IDOTA Naokazu
Field: Application
Institution: Waseda University
Authors:
N. Idota(1)(3), J. Kobayashi(2)(3), A. Kikuchi(2)(3), K. Sakai(1), T. Okano(2)(3)
Title:
Preparation of thermoresponsive hydrogel-grafted capillary tubings for elution control of hydrophobic bioactve compounds
Abstract:
Cross-linked thermoresponsiv poly(N-isopropylacrylamide) (PIPAAm) thin layer hydrogel-grafted surfaces on glass capillary inner walls were prepared to investigate the effect of thermoresponsive property on microfluid behavior. Height in water meniscus in PIPAAm hydrogel-grafted capillary was significantly changed at 30 degree centigrades, caused by temperature-dependent hydrophilic / hydrophobic surface property alterations. Retention time of hydrophobic steroids delayed with increasing temperature in PIPAAm hydrogel-grafted capillary inner surfaces due to increased hydrophobic interaction. Consequently, elution of hydrophobic bioactive compounds can be readily controlled without column packed silica beads through the modulation of the specific surface area.

Presenter: IIO Kokoro
Field: Properties
Institution: National Institute of Advanced Industrial
Authors:
K. Iio(1), K. Hirayama(2)

Title:
Swelling characteristics of semi-IPN type hydrogel composed of polyallylbiguanide and poly(N-isopropylacrylamide)

Abstract:
Polyallylbiguanide HCl (PAB) was synthesized by the radical polymerization of allylbiguanide. Semi-IPN type hydrogel of PAB and poly (N-isopropylacrylamide) (PNIPAAm) was prepared by the radical polymerization of N-isopropylacrylamide and methylenebisacrylamide in an aqueous solution in the presence of PAB. We found that this hydrogel displays a remarkable pH and temperature response. The swelling characteristics of hydrogel are determined by the measurement of hydrogel's length and by using the spectrographic method. The area ratio (d/n) of the stretching (n) and bending vibration (d) of methylene group in the hydrogel by the Raman spectra or the ATR-IR spectra are estimated the swelling behavior of the hydrogel, and are compared with the length method.

Presenter: IIZAWA Takashi
Field: Others
Institution: Hiroshima University
Authors:
T. Iizawa, Y. Onohara, Y. Matuura

Title:
Synthesis of poly(N-alkylacrylamide) Copolymer Gels and Their Swelling Behavior

Abstract:
Poly(N-alkylacrylamide) gels with C2-C3 alkyl groups would have lower critical temperature (LCT) in water, however; the LCT of (N-alkylacrylamide) gels, except for poly(N-isopropylacrylamide) gel, has not been reported in detail. Recently, we have studied successful synthesis of poly(N-isopropylacrylamide) gel from amidation of poly(acrylic acid)-DBU salt (DAA) with isopropylamine using triphenylphosphite as an activating agent. This study reports synthesis of poly(N-alkylacrylamide) gels from amidation of DAA with alkylamines. Temperature dependency of their equilibrium swelling ratio in water is measured. Especially, copolymer gels of N-isopropylacrylamide and N-n-propylacrylamide prepared by the reaction of DAA with mixtures of isopropylamine and n-propylamine showed interesting swelling-deswelling behavior.

Presenter: IKKAI Fumiyoshi
Field: Structure
Institution: L'OREAL Recherche
Authors:
F. Ikkai(1), M. Shibayama(2)

Title:
Microstructure of Weakly-Charged Polymer Gel Particles

Abstract:
We discussed the microstructure of submicron gel particles consisting of weakly-charged N-isopropylacrylamide, which shows volume phase transition depending on temperature. SANS profiles at 60 ｡C obeyed the Porod law, indicating that the particle has a smooth and rigid surface. Interestingly, the SANS profiles at 60 ｡C did not show a peak reflecting the microphase separation, which is usually observed for the mm-size gel. This indicated that the microphase separation depends on the gel size. In this case, the size of the gel particle (ca. 66 nm) was not large enough to undergo microphase separation (ca. 30 nm).

Presenter: INOUE Yukihiko
Field: Structure
Institution: Akita University
Authors:
Y. Inoue(1), T. Sato(1), and N. Ohtani(1)

Title:
Swelling behavior of cationic acrylamide gels containing anionic surfactant in water-organic media mixed solvent.

Abstract:
Swelling behavior of trimethylammonium-substituted acrylamide gels containing sodium dodecylsulfate (SDS) in water-organic solvent mixture was investigated. The gels containing SDS exhibited volume maxima at the middle of the solvent composition, and shrank in water and in acetone. The behavior was quite different from that of the gels which did not contain SDS. Similar behavior was observed in other water-organic solvent systems. The scope and limitation of the behavior will be discussed.

Presenter: IZUMI Yoshinobu
Field: Properties
Institution: Osaka Uiniversity
Authors:
Y.Izumi, S.Takeda, K.Ema, T.Terada, H.Yamamoto, S.Nishijima

Title:
Fundamental Study on Radiation-Induced Gelation Process for Various Polymers

Abstract:
The swelling behavior of various kinds of radiation-induced polymer gels as well as their polymerization, cross-linking, and sol-gel transition processes were investigated by equilibrium swelling measurement, dynamic light scattering, ultrasonic spectroscopy, potentiometric titration method, and densitometry. Various kinds of monomer solutions were irradiated by gammma-ray and UV to induce polymerization. The relation between equilibrium swelling degree of gel and the polymerization process were particularly focused when the radiation dose, the pH of solution, and temperature were changed,respectively. The obtained results showed that ultrasonic spectroscopy, potentiometric titration method, and densitometry allow us to have the new insight into a polymerization and sol-gel transition processes.

Presenter: KAGATA Go
Field: Properties
Institution: Hokkaido University
Authors:
G. Kagata(1), T. Tominaga(1), J.P. Gong(1,2), Y. Osada(1)

Title:
Static Friction between Like-Charged polyelectrolyte Gels

Abstract:
In this study, the behavior of the static friction between like-charged gel surfaces was investigated. Despite of the repulsive interface nature, it was found that the two gel surfaces could not slip with each other until the shear stress acting on the interface exceeded over a critical value. In addition, this critical value of stress depended clearly on the species of counter-ion of charged gel. This result indicates that the hydrated state of counter-ions at the interface is important and should be taken into account for the generation of the static friction observed between two like-charged gels.

Presenter: KARINO Takeshi
Field: Structure
Institution: University of Tokyo
Authors:
T. Karino(1), S. Okabe(1), M. Shibayama(1), Y. Domon(2), Y. Okumura(2), K. Ito(2)

Title:
Small Angle Neuron Scattering from Sliding Gel

Abstract:
Polymer gels are known to have spatial heterogeneities. This is partially due to the presence of cross-linking points that restrict motion of network chains. Can these heterogeneities of gel decrease if cross-linking point moves freely? We synthesized a novel gels consisting of polyrotaxane of cyclodextrin(CD) and poly(ethylene glycol)(PEG). Due to dimerization of CDs, CDs can move freely along the PEG chains like a pulley. This gel, we hereafter call a sliding gel, has not only good tensile strength but also a very large swelling capability in water. We carried out small angle neutron scattering experiments in order to compare chemically cross-linking gels and sliding gels. In contrast with chemical gels, the scattering intensities of sliding gels increased with decreasing cross-link density. In a stretch experiment, the sliding gels showed a 'normal' butterfly pattern, which is different from chemical gels. It is concluded that the sliding gels is classified to be a new class of gels with extremely low spatial heterogeneities.

Presenter: KATO Eiji
Field: Others
Institution: Kobe University of Mercantile Marine
Authors:
Eiji Kato

Title:
Anti-Stokes fluorescence from rhodamine dyes in polymer gels

Abstract:
It has been known that organic dyes such as rhodamine B and rhodamine 101 emit anti-Stokes fluorescence, yellow light of which peak wavelength is around 600nm, in water and methanol by the excitation of red light with a shorter wavelength from a He-Ne laser at 632.8nm. This is frequency (energy)-upconverted luminescence emitted from thermally activated molecules. It suggests the possibility of optical cooling. In this presentation, we are going to report anti-Stokes properties of these dyes in hydrogels, poly(N-isopropylacrylamide gels and acrylamide gels. The properties in swollen gels and those in shrunken gels are examined.

Presenter: KATO Norihiro
Field: Properties
Institution: Utsunomiya University
Authors:
N. Kato(1), H. Suzuki(2), Y. Sakai(3), S. H. Gehrke(4)

Title:
Fast deswelling of microporous cellulose ether gel prepared by freeze-drying

Abstract:
For most applications of stimuli-sensitive gels, the response rate of the gel is a critical factor;increasing the response rate is necessary for successful development of these applications. In this presentation, fast-deswelling of cellulose ether gel, a thermally sensitive gel, will be discussed in connection with the porous structure of the polymer network. Freeze-drying and subsequent hydration in water are the way of accelerating the deswelling of gels. SEM images showed the porous structures formed in the freezing process of the gels. The pore size of the gel could be easily controlled with altering water content in the gels before freezing.

Presenter: KIMURA Noriko
Field: Application
Institution: Tokyo University of Agriculture and
Authors:
N.Kimura(1), Y.Lu(2), T.Watanabe(3), K.Totani(4), A.Oguni(5),I.Harada(6),T.Akaike(7)

Title:
Microfabrication of hydrogel by using two-photon initiated polymerization

Abstract:
Two-photon absorption can be defined as the simultaneous absorption of two photons. Recently two-photon initiated polymerization (TPIP) has attracted attention because it has much higher spatial 3-D resolution than one-photon initiated polymerization, which offers micron and submicron objects. We fabricated submicron hydrogel structure by using TPIP initiated. It is very important for tissue engineering to fabricate extracellular matrix (ECM) hydrophilicity. In this persentation, we will discuss effects of shape and elastic modulus of hydogel ECM fabricated by TPIP on cell function of hepatocyte.

Presenter: KISHI Ryoichi
Field: Properties
Institution: National Institute of Advanced Industrial
Authors:
R. Kishi(1), T. Miura(1), H. Kihara(1), K. Fujieda(2), M. Okabe(2)

Title:
Poly(N-isopropylacrylamide) Hydrogels Prepared by Crosslinking of Telecheric Polymers

Abstract:
Recently, there are many studies on poly (N-isopropylacrylamide)(PNIPAAm) gels for its functions and properties, however almost PNIPAAm gels were prepared by radical copolymerization of N-isopropylacrylamide (NIPAAm) monomer with crosslinking monomer, such as N, N' -methylenebis(acrylamide). In this study, PNIPAAm gel having different network structure was prepared by crosslinking of the telecheric PNIPAAm having di-terminated carboxyl groups with tri-functional aziridinyl compound in dioxane. The obtained PNIPAAm organo-gel changed to hydrogel by solvent substitution in large amount of water at room temperature. The hydrogel showed the thermal volume transition similar to the radiacal polymerized gels.

Presenter: MATSUMOTO Akira
Field: Application
Institution: The University of Tokyo
Authors:
A. Matsumoto and K. Kataoka

Title:
Development of Totally Synthetic Glucose Responsive Gel with Phenylboronic Acid derivative as Sensor Moiety

Abstract:
In order to adjust our phenylborate-based glucose responsive polymer gel system to be operated under physiological conditions, modifications were employed to the chemical structure of the system. In attempt to improve the operational pH condition, we prepared a novel phenylboronic acid containing monomer with a decreased pKa. The main chain structure was also changed to poly(N-isopropylmethacrylamide) which exhibits a higher transition temperature than that of PNIPAAm, intending to improve the operational temperature. The improved operational system was examined by drawing glucose, pH and temperature dependent volume changing curves of the gel. Discussion was made in terms of the effect of the modulated structure on the glucose responsive behavior.

Presenter: MATSUOKA Tatsuro
Field: Properties
Institution: Nagoya University
Authors:
T. Matsuoka(1), Y. Nakamura(2), S. Koda(3)

Title:
Surface wave and DSC study of methylcellulose hydrogel in drying process

Abstract:
Surface wave measurements of the methylcellulose (MC) gel in drying process were carried out at constant temperature and humidity. The surface wave velocity kept an almost constant value during a certain period (0.5 to 6 hours) and after that period it increased with time for the sample whose molecular weight is below 100,000. The DSC measurements were also performed for the sample at different depth after drying experiments. The results will be discussed it terms of the gel network and the state of water in MC gels.

Presenter: MIWA Kumi
Field: Theory
Institution: Ochanomizu University
Authors:
K. Miwa(1), T. Deguchi(1)

Title:
Simulation of gelation processes and time evolution of scattering intensities through a CCA model with mixed functionalities

Abstract:
We study the gelation processes by simulation of a cluster-cluster aggregation (CCA) model, in which networks of gels are constructed through clustering of two-functional or four-functional monomers. We find that gelation time increases when the initial concentration of monomers decreases, while it decreases when the fraction of four-functional monomers increases. At a small initial concentration, gelation time does not markedly depend on the functionality of monomers. This can be related to the forms of clusters. And we discuss the scattering functions of the cluster patterns or the gels generated in the gelation process given by the cluster algorithm.

Presenter: MORIMOTO Nobuyuki
Field: Application
Institution: Tokyo Medical and Dental University
Authors:
N. Morimoto(1), Y. Iwasaki(1), K. Akiyoshi(1)

Title:
Nanogel engineering : polymerizable self-assembled nanogel

Abstract:
We have been proposed the novel methods to prepare the hydrogel-structured nanoparticle (nanogel). Choresteryl-bearing pullulans (CHP)s form stable monodispersive nanogels (20-30 nm) by inter-macromolecular self-association in water. We reported that CHP nanogels are useful for drug carrier or artificial molecular chaperon. In this study, partially methacrylated CHP (CHPMA) was synthesized to improve the stability and usefulness of CHP nanogels by another intermolecular cross-linking with covalent bonds. The solution property of prepared nanogels were investigated by size excursion chromatography (SEC)- multi angle laser light scattering (MALS).

Presenter: NAKA Yosuke
Field: Material
Institution: Kansai University
Authors:
Y. Naka(1), M. Doura(2), H. Aota(3), A. Matsumoto(4)

Title:
Novel Amphiphilic Network Polymers Consisting of Short Primary Polymer Chains and Long Crosslink Units with Opposite Polarities

Abstract:
Solution copolymerizations of benzyl methacrylate or 2-hydroxyethyl methacrylate with 5 mol% of tricosaethylene glycol dimethacrylate or heneicosapropylene glycol dimethacrylate, respectively, were carried out in the presence of different amounts of lauryl mercaptan, providing novel amphiphilic vinyl-type network polymers consisting of short primary polymer chains and long crosslink units with opposite polarities. The vinyl-type network polymers formed via highly branched prepolymers have abundant dangling chains as their characteristic feature, especially when the primary polymer chain length is short. The amphiphilicity of the resulting gels was checked by measuring their swelling ratios in the mixed solvents with opposite polarities.

Presenter: NAKAMA Tsuyoshi
Field: Properties
Institution: Japan Advanced Institute of Science and
Authors:
Tsuyoshi NAKAMA, Tooru OOYA, Nobuhiko YUI

Title:
Construction of Supramolecular-Structured Hydrogels based on Inclusion Complexation between Poly(ethylene glycol) Grafted

Abstract:
Poly(ethylene glycol)-grafted hyaluronic acid (PEG-g-HA) was synthesized by condensation reaction of hyaluronic acid with hydrazide-terminated PEG. Supramolecular-structured hydrogels were formed by adding predetermined amounts of alpha CDs (EG/CD = 1/1~3/1) in the PEG-g-HA solutions. Inclusion complexation and Hydrogel formation were confirmed by X-ray diffraction and CP/MAS NMR spectroscopic measurements. In the case of 2:1 inclusion complex, gelation occurred at the concentration above 3 wt% of PEG-g-HA. These results indicate that the physically cross-linked points, formed by PEG/alpha CD inclusion complexation, play a role in the hydrogel formation. The physicochemical behaviors of these hydrogels in response to pH and temperature will be reported.

Presenter: NAKANISHI Takayuki
Field: Structure
Institution: Kyoto Institute of technology
Authors:
T. Nakanishi(1), T. Norisuye(1), Q. Tran-Cong-Miyata(1), S. Nomura(2), T. Sugimoto(2)

Title:
Studies on Microscopic Structure of Sol-Gel Derived Polymer Hybrids Containing Heteropoly Acid.

Abstract:
Structural analysis of organic - inorganic polymer nano - hybrids consisting of alkylene - bridged silsesquioxane and heteropoly acid has been conducted by using atomic force microscopy(AFM) and small angle x-ray scattering(SAXS). The polymer hybrids with different bridge lengths and functional groups were synthesized. The domain size and the correlation length were evaluated as a function of acid concentrations by means of reciprocal space analysis. As a result, it was found that acid concentrations played an important role in the structure of the bulk cast film. The detail will be discussed in the presentation.

Presenter: NISHINARI Katsuyoshi
Field: Properties
Institution: Osaka City University
Authors:
Y.Nitta, S.Gao, R.Takahashi, K.Nishinari

Title:
Effects of gelation rate on the rheological properties of polysaccharides

Abstract:
In the present study, previous studies on the effects of gelation rate on the elastic modulus of polysaccharide gels are reviewed, and some recent results on gellan and konjac glucomannan will be discussed in comparison with these previous studies. Effects of gelation rate on the rheological and related properies of gels of gellan gum were studied. Differential scanning calorimetry and circular dichroism measurements were performed to detect the helix-coil transition.

Presenter: NONAKA Takamasa
Field: Application
Institution: Kumamoto University
Authors:
T.Nonaka(1). A.Yasunaga(2),T.Ogata(3),S.Kurihara(4)

Title:
Synthesis of hydrophilc copolymer beads having phosphinic acid groups and their properties

Abstract:
Hydrophilic copolymer beads were prepared by suspension copolymerization of acryloyloxypropyl n-octyl phosphinic acid group(APPA) and N-alkylacryl-amide(NAAm), and tetraethylene glycol dimethacrylate(4G) in saturated Na2SO4 solution. The thermosensitivity of the APPA-NAAm-4G copolymers and their adsortion ability for metal ions were investigated.

Presenter: NORISUYE Tomohisa
Field: Structure
Institution: Kyoto Institute of Technology
Authors:
Tomohisa Norisuye, Yusuke Kida, Naoki Masui, Qui Tran-Cong-Miyata, Yasunari Maekawa, Masaru Yoshida, Mitsuhiro

Title:
Studies on Two Types of Sptial Inhomogeneities for Polymer Gels

Abstract:
Shrinking kinetics and microscopic structure of poly(N-isopropylacrylamide)(PNIPA) gels have been studied for two types of PNIPA gels prepared by (i) copolymerization of constituent monomer and cross-linker (monomer cross-linked gels) and (ii) γ -ray irradiation in the PNIPA solutions(polymer cross-linked gels) in order to investigate the role of cross-linking on shrinking kinetics. The rapid shrinking is attained by simply lowering the cross-linking density for both types of gels with a skin formation. On the other hand, significant difference was found when the microscopic structure and the dynamics were investigated by small angle neutron scattering (SANS) and static/dynamic light scattering (SLS/DLS).

Presenter: OHTANI Noritaka
Field: Structure
Institution: Akita University
Authors:
N. Ohtani(1), H. Kuroyanagi(1), T. Yamashita(1)

Title:
Temperature and Phenol-Sensitive Hydrogels Based on Poly(vinylbenzyltrialkylammonium chloride)

Abstract:
We ecently disclosed that benzyltrialkylammonium halides afford LCST properties in electrolyte solutions and UCST properties in aqueous phenolic solutions. We show in this presentation that the hydrogels derived from vinylbenzyltrialkylammonium chloride give unique swelling behaviors due to their phase-transitions in electrolyte or phenol aqueous solutions. Effects of temperature and electrolyte or phenol concentration on the volume-phase-transition were examined in detail.

Presenter: OKABE Satoshi
Field: Structure
Institution: The University of Tokyo
Authors:
S. Okabe(1), S. Sugihara(2), S. Aoshima(2), M. Shibayama(1)

Title:
Study on the Structure and Dynamics of a Thermo-Sensitive Block Copolymer Aqueous Solution

Abstract:
The structure and dynamic properties of poly(2-ethoxyethyl vinyl ether)-b-poly(2-hydroxyethyl vinyl ether) in aqueous solutions were investigated by means of small-angle neutron scattering (SANS), dynamic light scattering (DLS), and rheological measurements. With increasing temperature, the solution underwent two-step transition around 20 。C, i.e., a micellization and macrolattice formation with a body centered cubic symmetry. These transitions took place in narrow temperature windows (in about 1 C, respectively), which well explained sharp rheological transitions from Newtonian, non-Newtonian, and plastic flow behaviors. DLS results also indicated formation of a physical gel as an appearance of non-ergodicity in the plastic flow region.

Presenter: OKAMOTO Noriko
Field: Material
Institution: Kansai University
Authors:
N. Okamoto(1), H. Aota(2), A. Matsumoto(3)

Title:
Preparation of Novel Core/Corona Nanospheres by Free-Radical Post-Copolymerizations of Crosslinked Poly(allyl methacrylate)

Abstract:
Crosslinked poly(allyl methacrylate)s (PAMA nanospheres) were prepared by the emulsion polymerization of AMA as the reactive crosslinked polymer nanospheres with abundant allyl groups. The free-radical post-copolymerizations of PAMA nanospheres with various vinyl monomers were conducted in the presence of lauryl mercaptans to prevent a bimolecular termination of growing polymer radicals leading to the formation of a crosslink between PAMA nanospheres. The resulting core/corona nanospheres were characterized by light scattering and viscosity measurements. Novel core/corona nanospheres were applied to the preparation of novel network polymers by the copolymerization with vinyl monomers.

Presenter: OKUMURA Yasushi
Field: Properties
Institution: University of Tokyo
Authors:
Y. Okumura(1,2), T. Kataoka(1), K. Ito(1,2)

Title:
Viscoelastic properties of topological gels

Abstract:
Recently, we synthesized new gels from polyrotaxanes in which poly(ethylene glycol) chain with large molecular weight is sparsely included by alpha-cyclodextrins. By chemically cross-linking cyclodextrins contained in the polyrotaxanes in solutions, we got transparent gels with good tensibility, low viscosity, and large swellability in water. In this gel, the polymer chains with bulky end groups are topologically interlocked by 'figure-of-eight cross-links'. Therefore, the polymer chains freely pass through the cross-links acting like pulleys, which is supposed to automatically equalize the nanoscopic heterogeneity in structure and stress. We call the new gel 'topological gel'. In this presentation, we report unique nonlinear viscoelastic propertiesof the topological gel.

Presenter: OZEKI Sumio
Field: Structure
Institution: Shinshu University
Authors:
Sumio Ozeki(1), Ichiro Ohtsuka(1), Hideya Kawasaki(2), and Hiroshi Maeda(2)

Title:
Induced Volume Phase Transition of Hydrogels prepared under Steady Magnetic Fields

Abstract:
When gels of poly(N-isopropylacrylamide) and polyacrylamide were prepared under magnetic fields up to 30T, the diameter of the cylindrical gels in the swelling state was much larger (ca. 40% at 30T) than that of the zero-field gels, owing to increase in dangling bonds. The swelling ratio depended markedly on the direction of the magnetic field against the cylinder axis because of the structural anisotropy that was deduced from the magnetic susceptibility measurements. Even though the zero field gels showed no volume phase transition, high magnetic fields induced the volume phase transition.

Presenter: PEKEL Nursel
Field: Material
Institution: HACETTEPE UNIVERSITY
Authors:
N.PEKEL(1), F.YOSHII(2), T.KUME(2), O.GUVEN(1)

Title:
PREPARATION OF HYDROXYPROPYLMETHYLCELLULOSE HYDROGELS USING E-BEAM

Abstract:
Later I will give a short abstract.

Presenter: SAKAI Takamasa
Field: Material
Institution: The University of Tokyo
Authors:
T.Sakai(1), S.Ito(2), T.Yamaguchi(2) and R.Yoshida(1)

Title:
Self-oscillating nano-gel particles.

Abstract:
We have prepared the copolymer of N-isopropylacrylamide (NIPAAm) in which ruthenium tris(2,2'-bipyridine) (Ru(bpy)3), a catalyst for the Belousov-Zhabotinsky (BZ) reaction, is covalently bonded to the polymer chain. When the polymer chain is dissolved in the aqueous solution containing BZ substrates except for the catalyst, periodical soluble-insoluble changes of the polymer are spontaneously induced by the BZ reaction. The periodic conformational changes of the polymer were measured as the optical transmittance changes of the solution. In this study, we prepared the nano-gel particles by emulsion polymerization. And swelling-deswelling oscillations of the nano-gel particles were measured as the optical transmittance changes of the suspension.

Presenter: SAKOHARA Shuji
Field: Application
Institution: Hiroshima University, Japan
Authors:
R. Kanazawa, S. Sakohara

Title:
Separation of Heavy Metal Ions by Using Molecular Imprinted Thermosensitive Gels

Abstract:
A new absorbent composed of thermosensitive gel which adsorb and desorb heavy metal ions by temperature swing was developed. The gel were prepared by copolymerizing N-isopropylacrylamide as thermosensitive component and N-(4-vinylbenzyl)etylenediamine as chelating monomer by using the technique of molecular imprinting. Copper ion was selected as a heavy metal ion to be imprinted. The adsorption amount of copper ion depends on the temperature, and the adsorption/desorption by temperature swing and selective adsorption of copper ion was observed as expected.

Presenter: SATO Shizuko
Field: Structure
Institution: Nagoya City University
Authors:
S. Sato, K. Tagami, M. Yonese

Title:
porous polyvinyl alcohol hydrogel

Abstract:
A porous hydrogel of polyvinyl alcohol was formed in the presence of gold nanoparticles, which were prepared from an aureate ion and an acetylenic glycol nonionic surfactant. The gel largely swelled in water. The swollen gel shrank by heating. The swelling and the shrinking of the gel were reversible and repeatable. An image of confocal laser scanning microscope of the swollen gel showed a sponge-like structure. From an image of scanning electron microscope of the shrunk gel, it was suggested that the gel had a highly complex structre with a numerous pores of micrometer size.2003.3.25-Tue-16:44

Presenter: SUZUKI Makoto
Field: Structure
Institution: Tohoku University
Authors:
M. Suzuki(1), S.R. Kabir(1), U.S. Nazia(1), K. Mihashi(2), T. Kodama(3)
Title:
Hyper-mobile water around actin filaments observed with high-resolution microwave dielectric spectroscopy
Abstract:
It is generally accepted that the water molecules in the immediate vicinity of the protein surface are restrained from thermal motions and hence less mobile than in the bulk phase. However, here we show an unprecedented finding made using a high-resolution technique of microwave dielectric spectroscopy that besides ordinary restrained (hydration) water, there exists a water component with rotational mobility much higher than that of bulk water around actin filaments (F-actin).

Presenter: TACHABOONYAKI Wanpen
Field: Application
Institution: Japan Science and Technology Corporation
Authors:
W. Tachaboonyakiat(1), T. Furubayashi(1), M. Katoh(2), T. Ooya(3), N. Yui(3)
Title:
Fabrication of macroporous hydrolyzable polyrotaxane hydrogels as a novel polymeric scaffold for chondrocyte cultivation
Abstract:
Polyrotaxane, a supramolecular compound consisting of linear poly(ethylene glycol) threading with cyclic alpha-cyclodextrin, is a nontoxic and biocompatible polymer. Thus, the polyrotaxane is challenged to be considered as a novel material for chondrocyte tissue engineering. Cholesterol, a principal sterol in higher animal, was introduced onto macroporous polyrotaxane-crosslinked hydrogels to improve cell adhesion and proliferation because of its ability to insert into phospholipids bilayer membrane. Chondrocyte adhesion, proliferation as well as erosion behavior of the hydrogels will be reported in detail.

Presenter: TAKUSHI Eisei
Field: Material
Institution: Univ. of the Ryukyus
Authors:
E. Takushi(1), S. Nema(1), N. Yonekura(2)

Title:
An Application of Gel-glasslike transition in biopolymer gels

Abstract:
An existence of gel-glasslike transition point in biopolymer gel such as DNA, gelatin, agarose, plant leaves, foods, fruits and flowers is demonstrated. This phenomenon has unique and simple feature that the time-dependent mass-changes occured in a few stages during the dehydration process. The first and the final stages could be attributed to the loss of the weakly and strongly bounded waters involving in polymer networks, respectively. It is also suggested that plant leaves could be classified and the preservation of foods and friuts are characterized by the gel-glasslike transition point.

Presenter: TAN Noriko
Field: Structure
Institution: Tokyo university of Agriculture and
Authors:
Noriko TAN(1), Hidemitsu FURUKAWA(1), Kazuyuki HORIE(1), and Rikio YOKOTA(2)

Title:
Synthesis and Light Scattering of Transparent polyimide Gels with Rigid Main-chains

Abstract:
Vinylpolymer gels have been intensively studied but they inevitably have structural defects, that is, large-scale inhomogeneities induced by the concentration fluctuation in radical polymerization. To avoid such defects, we have focused on polyimide gels, synthesized them by polycondensation, and developed the method to prepare the homogeneous network-structure of polyimide gels. In this study, transparent polyimide gels prepared from oligoisoimides and an end-crosslinker were obtained. The network structure of the system of the polyimide gels was studied with scanning dynamic light scattering. The effect of varying the preparation condition such as polyimide concentration and methods of imidization on the network structure will be discussed.

Presenter: TANIGUCHI Takashi
Field: Theory
Institution: Yamagata University
Authors:
T. Taniguchi, T. Mitumata, and K. Koyama

Title:
Theoretical Explanation of Anisotropic Elastic modulus of Magnetic Gel

Abstract:
We derived the analytic expression of elastic modulus for a gel containing magnetic particles with the same magnetic dipole moment. The obtained elastic modulus is anisotropic and the modulus increases and decreases with the density of magnetic particle when the direction of strain is perpendicular and parallel to the direction of magnetization, respectively. This behavior is qualitatively in good agreement with previous experimental data.

Presenter: TSUJI Sakiko
Field: Properties
Institution: KEIO University
Authors:
Sakiko TSUJI and Haruma KAWAGUCHI

Title:
Properties of environment-responsive hairy particles and their dispersion

Abstract:
Hairy particle which has mainly consisting of poly(N-isopropylacrylamide) (PNIPAM) shell layer was synthesized. The hairy layer was prepared by graft polymerization on core particle using living radical polymerization technique. The particle with PNIPAM hair changed their hydrodynamic diameters reversibly and sharply around 33℃. The core-hair structure was clearly observed by TEM and SEM. Also, the hairy particles neatly arrayed on the substrate, especially nicely on a polystyrene surface, by air drying. The dispersion gelled under a selected condition even if it was sufficiently diluted at room temperature.

Presenter: TSUTSUI Hiroaki
Field: Application
Institution: Fuji Xerox Co. Ltd.
Authors:
H. Tsutsui, A. Komura, M. Mikami, R. Akashi

Title:
Novel Light Modulation Polymer Gel Materials Imitating Pigment Cell VI---Design and fabrication of a light modulator with a light

Abstract:
We have developed a new type of light modulator with a light modulation gel layer. The light modulatior was prepared as following process; Colored N-isopropylacrylamide (NIPAM) gel particles were dispersed into water-soluble UV curable resin solution, and then, the dispersion was coated on a substrate. UV radiation solidified the resin part and formed a continuous gel layer in which NIPAM gels were fixed. According to temperature increase, the NIPAM gels showed volume phase transition in the gel layer and the transmittance of the light modulatior was altered from 20% to 70%. In addition, this light modulatior has high visibility and durability.

Presenter: UESUSUKI Yusuke
Field: Material
Institution: The University of Tokyo
Authors:
Y.Uesusuki, R.Yoshida

Title:
Self-Oscillating Drug Release Systems Using pH-Responsive Gels

Abstract:
From recent studies in chronopharmacology, the effect of drugs changes against time periodically synchronized with biorhythms. In this study, we designed the autonomous oscillating DDS to release drug in preprogrammed pulsatile manner under constant condition by using pH-responsive hydrogel. We prepared pH-responsive hydrogel containing hydrophobic component to cause Case-II diffusion during swelling process and form clear skin layer during shrinking process. By repeating swelling and shrinking, multi-layer structure was formed within the gel. The multi-layer structure of the gel was observed by fluorescence microscope. Release rate of model drug theophylline from the gel with multi-layer structure was found to be oscillating pattern with three peaks.

Presenter: YAMAGISHI Tada-Aki
Field: Theory
Institution: Kanazawa University
Authors:
T.Yamagishi(1), H.Yuboku(2), G.Konishi(3), Y.Nakamoto(4)

Title:
Computational Study on the Gelation of Phenolic Resins

Abstract:
A new computer simulation method was applied to the gelation of phenolic resins. The simulation was carried out by the two and three dimensional lattice models according to a Monte Carlo algorithm. The simulation parameters were 1) molecular weight of phenolic resins, 2) molar ratio of formaldehyde to phenol, and 3) reactivity of phenol monomer to polymers. The gelation included intermolecular and intramolecular reactions. The reactivity of the gel was compared with that of the sol. The structure of the gel changed by the reactivity of the sol.

Presenter: YAMASHITA Tsuyoshi
Field: Structure
Institution: Akita University
Authors:
T. Yamashita(1), H. Kuroyanagi(1), K. Mori(1), N. Ohtani(1)

Title:
Effect of Counter-ions of Ionic Hydrogels on Thermo-Sensitive Swelling Behavior.

Abstract:
We have shown that the hydrogels derived from vinylbenzyltributylphosphonium salts are both thermo-sensitive and brine-sensitive. This is due to LCST properties of quaternary phosphonium salts with relatively symmetric structures in aqueous electrolyte solutions. We show in this study that the kind and concentration of counter-ions greatly affect the volume-phase-transition of the ionic hydrogels. Introduction of hydrophobic counter-ions tends to decrease the transition temperature.

Presenter: YAMAUE Tatsuya
Field: Theory
Institution: Nagoya University
Authors:
Tatsuya Yamaue (1), Masao Doi (2)

Title:
The Simulation of the Swelling Dynamics of Gels by the Stress-Diffusion Coupling Model

Abstract:
We have developed the simulator for large deformation of gels using the stress-diffusion coupling model of gels, and applied it to the swelling dynamics of a long rod and a large plate shaped gel. In the stress-diffusion coupling model, we consider both the diffusion of solvent and the elastic deformation of gels based on two fluids model. This model is able to reproduce some of experimental results for anisotropic shaped gels, which cann't be reproduced by the conventional collective diffusion model of gel networks. In this paper, the availability of the stress-diffusion coupling model of gels is discussed for the swelling phenomena of anisotropic shaped gels.2003.3.21-Fri-17:7

Presenter: YATA Mashiko
Field: Material
Institution: Kansai University
Authors:
M. Yata(1), H. Aota(2), A. Matsumoto(3)

Title:
Gelation in Free-Radical Crosslinking Allyl Benzoate/Diallyl Terephthalate Copolymerization in the Presence of Reactive

Abstract:
The clarification of polymerization characteristics of microgel is considered to be significant because microgelation leads not only to delayed gelation, but also to the inhomogeneity of network structures of three-dimensional crosslinked polymers as closely related to their properties. Thus, microgel-like poly(allyl methacrylate) nanospheres (PAMA nanospheres) with abundant pendant allyl groups were prepared by the emulsion polymerization of AMA as pseudo-microgels. Then, the addition effect of pseudo-microgels on the gelation behavior was examined in detail in the free-radical crosslinking allyl benzoate/diallyl terephthalate copolymerizations in which no microgelation was observed.

Presenter: YOKOKAWA Seiichiro
Field: Properties
Institution: The University of Tokyo
Authors:
S. Yokokawa (1), S. Kuga (2)

Title:
Pregel transitions of aqueous agarose system

Abstract:
We studied gelation of aqueous agarose system by light scattering, with careful stabilization during cooling, and found new aspects of the process. Gelation behavior was basically different for above and below 0.6~0.8%. Below 0.6%, the system formed gel in one step; Above 0.8%, the sytem showed two pregel transitions at 61˚C and 51˚C, with peculiar fluctuation of scattering intensity, and finally formed gel at approx. 35˚C. In high temperature region, 1.0% agarose solution contained certain molecular clusters. Two intermediate states were identified in the cooling process. Complete gelation caused loss of scattering intensity correlation in time range between 1 us and 1s, indicating high rigidity of the gel network.

Presenter: YONEKURA Nobuaki
Field: Application
Institution: University of the Ryukyus
Authors:
N.Yonekura, E.Takushi

Title:
Molecular recognition by DNA hydrogel

Abstract:
DNA hydrogel is a network of chemically crosslinked DNA strands and has been expected to be able to recognize various DNA binding substrates. We have studied the molecular recognition of cationic dyes with different DNA binding modes and DNA condensing cationic proteins and polyamines by the volume change of the gel and the change of anion concentrations in the gel induced by binding of the cations.

Presenter: YOSHIKAWA Mayumi
Field: Properties
Institution: Tokyo University of Agriculture and
Authors:
Mayumi YOSHIKAWA, Hidemitsu FURUKAWA, Toshiyuki WATANABE, Kazuyuki HORIE

Title:
Photoreaction-Induced Control of Network Structure in Polymer Gels Study with Scanning Microscopic Light Scattering

Abstract:
For realizing the photoreaction-induced control of network structure, we tried to synthesize polyimide gels containing azobenzene groups as photo-sensitive moieties. The trans-cis photoisomerization of azobenzene groups occur by UV irradiation. It was found that UV light induces the local change in volume to bend the gels. The photoreaction-induced change in its network structure was studied with scanning microscopic light scattering (SMLS). The change in mesh-size (2.1nm⇔0.83nm) was observed. Both nanomater-scale and macromater-scale changes were correlated to each other for the first time.

Presenter: YOSHINARI Etsuko
Field: Structure
Institution: Tokyo University of Agriculture and
Authors:
E. YOSHINARI, H. FURUKAWA, K. HORIE

Title:
Dynamic Light Scattering and Depolarized Fluorescence Spectroscopy of Grafted Poly(N-isopropylacrylamide) Gels

Abstract:
Grafted poly(N-isopropylacrylamide) (PNIPA) gels shrink more rapidly than normal PNIPA gels in response to a temperature jump. We investigated the rapid shrinking of the grafted gels by using scanning microscopic dynamic light scattering (SMLS), and found that the rapid shrinking results from defects of network structure from the reserch on two types semi-IPN gels. In addition, dansyl probes are attached to grafted chains or main chains of grafted gels, and the dynamics of the grafted chains and the main chains are independently investigated by using depolarized fluorescence spectroscopy. The obtained experimental results are compared with the results of SMLS measurements, in order to discuss the difference in the dynamics of the main chains and the graft chains.

Presenter: ZHAO Changming

Field: Structure

Institution: University of Tokyo

Authors:
C. Zhao(1,2), Y. Okumura(1,2), Y. domon(1), K. Ito(1,2), S. Okabe(1), M. Shibayama(1,2)

Title:
Dynamic Light Scattering of Sliding Gel

Abstract:
Recently, we have synthesized a new kind of gel, sliding gel, in which figure-of-eight cross-links can move freely on the polymer chain. In this study, we tried to show that the figure-of-eight cross-links are actually moving on PEG chain network. We measured time correlation function of topological gel in the gelation process by dynamic light scattering (DLS). Different from chemical gels, we found two DLS mode in the sliding gel. Furthermore, we observed liquefaction process by removing bulky end groups. By comparing with PEG solution, alpha-cyclodextrin solution and polyrotaxane solution, we proved that the slower mode is sliding mode.