



BIOPOLYMERS MEETING 2017

DAY 1 SCIENTIFIC SESSIONS

ANNUAL MEETING ON

BIOPOLYMERS AND DRUG DELIVERY SYSTEMS

OCTOBER 12-13, 2017 OSAKA, JAPAN

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Concentration regimes of biopolymers xanthan, tara and clairana, comparing dynamic light scattering and distribution of relaxation time**Patricia Diaz de Oliveria¹, Ricardo C Michel², Alan J A McBride¹, Angelita da Silveira Moreira¹, Rosana F T Lomba³ and Claire T Vendruscolo¹**¹Federal University of Pelotas, Brazil²Federal University of Rio de Janeiro, Brazil³Well Engineering Technology Research and Development Centre Petrobras, Brazil

The aim of this work was to evaluate the utilization of analysis of the Distribution of Relaxation Time (DRT) using a dynamic light back-scattering technique as alternative method for the determination of the concentration regimes in aqueous solutions of biopolymers (xanthan, clairana and tara gums) by an analysis of the overlap (c^*) and aggregation (c^{**}) concentrations. The diffusion coefficients were obtained over a range of concentrations for each biopolymer using two methods. The first method analyzed the behavior of the diffusion coefficient as a function of the concentration of the gum solution. This method is based on the analysis of the diffusion coefficient versus the concentration curve. Using the slope of the curves, it was possible to determine the c^* and c^{**} for xanthan and tara gum. However, it was not possible to determine the concentration regimes for clairana using this method. The second method was based on an analysis of the DRTs, which showed different numbers of relaxation modes. It was observed that the concentrations at which the number of modes changed corresponded to the c^* and c^{**} . Thus, the DRT technique provided as an alternative method for the determination of the critical concentrations of biopolymers.

Biography

Patricia Diaz de Oliveira is an Adjunct Professor at Federal University of Pelotas, Rio Grande do Sul, Brazil. She holds a degree in Chemical Engineering from the Federal University of Rio Grande and a Doctorate in Biotechnology from Federal University of Pelotas. Presently, she is doing research at the Biopolymers Laboratory of UFPel.

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Modeling of phase behaviors for hydrogen bonding polymer solution using PC-SAFT equation of state**Bong-Seop Lee**

Kuyngnam University, Republic of Korea

Modeling of the phase behavior of polymer solutions is a crucial requirement to develop new polymer solution technologies and to design various polymer processes, such as purification, fractionation, devolatilization and polymer production. In particular, the Liquid-Liquid Equilibrium (LLE) calculation is essential for processes design of polymerization. The hydrogen bonding in polymer solutions leads to deviate remarkably from normal solutions behaviors and is a major cause of different phase behaviors. The perturbed-chain statistical association Fluid Theory (PC-SAFT) Equation of State (EoS) is applied to calculate the pressure-volume-temperature (PVT), infinite dilution weight fraction activity coefficient (WFAC), Vapor-Liquid Equilibrium (VLE) and Liquid-Liquid Equilibrium (LLE) of associating polymer mixtures with hydrogen bonding association such as self- and cross-association with various phase behaviors such as Upper Critical Solution Temperature (UCST), the Lower Critical Solution Temperature (LCST) and closed-loop of polymer solutions. The PC-SAFT model shows a satisfactory performance.

Biography

Bong-Seop Lee has his expertise in modeling the phase behaviors on organic molecules, polymers, biological molecules (i.e., amino acid, peptide) and electrolyte solutions (i.e., inorganic salt, ionic liquids). He has received his Master's degree and developed the electrolyte-PC-SAFT equation of state by combining PC-SAFT and primitive mean spherical approximation in his PhD course. In his Post-doctoral studies, he focused on the modeling of physical and chemical properties of ionic liquid mixtures. His research interest is in dissociation phenomena of weak and strong acids and the equilibrium of various materials (polymer, blend, organic solvent) at high pressure condition.

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Influence of surface charge density and NaCl concentration on the intrinsic viscosity of cellulose nanocrystal suspensionsSiqun Wang¹, Qian Li¹, Qiang Wu², Xiuwen Li² and Shenyuan Fu²¹University of Tennessee, USA²Zhejiang A&F University, China

Cellulose Nanocrystals (CNCs) with similar size and various surface charge densities were prepared by sulfuric acid hydrolysis and NaOH desulfation. The influence of surface charge density and NaCl concentration on the intrinsic viscosity of CNC suspensions and predicted aspect ratio were investigated by Ubbelohde viscometer. With decreased CNC surface charge density, the intrinsic viscosity initially decreased due to the electric double layers on the CNC surface and subsequently increased due to CNC aggregation. To screen electro viscous effect, NaCl was added into CNC suspensions. With increased NaCl concentration, the intrinsic viscosity of CNC suspensions first decreased and then increased. The aspect ratios of CNCs predicted by Batchelor equation from the minimum intrinsic viscosity were consistent with that measured by transmission electron microscopy (TEM). Suspensions of CNCs with higher surface charge density needed less NaCl to obtain minimum intrinsic viscosity. The NaCl content that should be added to the suspension to predict the actual physical aspect ratio of CNC can be estimated by Debye-Hückel theory, assuming that the Debye length is equal to the CNC diameter.

Biography

Siqun Wang is a Professor in the UT Center for Renewable Carbon. His research interests include nano-mechanics, cellulose nano-materials, bio-based carbon materials, manufacture and performance of wood-based composites, natural fiber-reinforced plastic composites, bio-nanocomposites, wood adhesion, cellulose nano-material impact on soil, soil recovery, heavy metal removal from water and wood quality. He has authored or co-authored more than 200 referred journal articles.

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Self-assembled tripeptide fibers as prebiotic RNA binders**Tony Z Jia**

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Before the emergence of the first RNA polymerase ribozyme, sustained non-enzymatic replication of RNA was crucial to the development of early life. To that end, cationic peptides have been hypothesized to be able to assist in template-directed non-enzymatic RNA polymerization by binding to and selectively inhibiting the annealing of long, complementary RNA strands. These strands can then act as templates for free primer strands, resulting in progressive replicative turnovers. However, the geochemical scenarios that would allow for the accumulation of high concentrations of long, cationic peptide oligomers are not likely. Recently, it has been discovered that certain tripeptide systems can spontaneously self-assemble into hydrogels and fibrillar macrostructures. As the accumulation of high concentrations of peptide trimers is much more likely than longer oligopeptides on the early earth, we probed the self-assembly properties and RNA-binding affinities of six tripeptides, each containing a cationic residue in the N-terminal position followed by an aromatic or hydrophobic dyad. KYF and RFF showed the best fibrillar self-assembly propensity-RFF is the first purely-peptidic arginine-containing tripeptide to self-assemble and microscopy and binding assays show that RNA indeed binds to the structures generated by these tripeptides. In fact, binding of a fluorescent RNA to cationic fibrillar macrostructures resulted in a direct label-free method of visualizing the kinetics of nanostructure assembly in real time. As these tripeptide assemblies are also reasonably heat-stable and do not prohibitively inhibit nonenzymatic RNA replication, our studies suggest that cationic tripeptide nanostructures could have been prebiotically-plausible RNA-binders, potentially possessing the ability to assist in the replication and eventual evolution of early genetic systems.

Biography

Tony Z Jia is a Researcher of the Earth-Life Science Institute at the Tokyo Institute of Technology in Tokyo, Japan. His research interests include prebiotic and ancient biopolymer formation and evolution.

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Thermogels as an injectable 3D scaffold**Byeongmoon Jeong**

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3D scaffolds with in situ forming properties have been extensively investigated for injectable tissue engineering applications. Chemical reactions or physical association triggered by change in external stimuli lead to the formation of the cell-incorporating hydrogel. However, to achieve the sustained delivery of growth factors, live cell retention and targeted differentiation into the cells are required in the in situ formed gel, which are based on the well-defined chemical and physical properties of a polymer. We have been developing thermogels which undergo solution-to-gel transition as the temperature increases. Mild and cytocompatible procedure for gel formation as well as capability to maintain a neutral pH during the degradation, polypeptide-based thermogels are proved to be an excellent platform for such purpose. As an injectable scaffold of stem cells, the physicochemical properties, the polypeptide thermogels and composite systems of the thermogels have been characterized. In addition, cell viability, differentiation of stem cells into target cells were monitored by using biomarker expressions and biofunctions of the differentiated cells. Polypeptide-based thermogels are very promising scaffolds for injectable tissue engineering applications and stem cell therapy to replace damaged/disease tissues in the future.

Biography

Byeongmoon Jeong has received his BS degree in the Department of Chemistry from Seoul National University, MS from KAIST and PhD in the Department of Pharmaceutics and Pharmaceutical Chemistry from the University of Utah. He has worked at Pacific Northwest National Laboratory, USA as a Senior Research Scientist prior to joining Ewha Womans University. He has authored 120 international peer-reviewed papers and patents on stimuli-sensitive polymers. He is also the Director of the National Research Laboratory on biodegradable thermogels. He was also a Fellow at Ewha Womans University and his research focuses on stimuli-sensitive hydrogels and their applications for drug delivery and tissue engineering.

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¹³C labeling gives insight into contribution of PHB precursors in *Synechocystis* sp. PCC 6803**Vaishali Dutt and Shireesh Srivastava**

International Centre for Genetic Engineering and Biotechnology, India

The freshwater cyanobacterium *Synechocystis* sp. PCC 6803 is known to accumulate polyhydroxybutyrate when under nutrient stress. Many aspects of PHB accumulation have been studied in this cyanobacterium but there is no study to shed light on the contribution of PHB precursors. In nitrogen deprived cells, higher amount of PHB accumulates with acetate supplementation. However, the quantitative contribution of externally added acetate for PHB synthesis is not known. Similarly, the quantitative contribution of newly-fixed carbon for PHB synthesis is not clear, though a previous study has shown that the photosystem I (PS-I) shows detectable photosynthetic activity up to 350 h of nitrogen starvation and so the cells continue to produce ATP and the reducing equivalent NADPH. In this study, using labeled substrates, we have shown that: (1) Externally added acetate, while increasing the intracellular PHB levels to over two-fold, contributes about 50% to PHB synthesis in either photo-autotrophic or mixotrophic growth, (2) The newly-fixed C is also a big contributor to PHB synthesis and mixotrophic pre-growth significantly reduces the contributions of newly-fixed C to PHB. Indirectly, the labeling studies also show that intracellular C recycling is an important source of precursor for PHB synthesis, irrespective of the pre-growth mode. Thus, this study provides novel insights into PHB synthesis by cyanobacteria by identifying the quantitative contribution of precursors for PHB synthesis and the effect of pre-growth.

Biography

Vaishali Dutt has obtained her BS and MS degrees in Zoology from University of Delhi, India. She has qualified the CSIR-UGC National Eligibility Test and was awarded Fellowship to conduct research in the life sciences. Her research focuses on understanding the PHB accumulation in photosynthetic bacteria, strategies to enhance the accumulation of this polymer and engineering of cyanobacteria to synthesize biofuel candidates.

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Preparation of intelligence antibacterial films based on low density polyethylene and evaluation of its properties**Pouria Atabaki Pasdar and B Bahari Aban**
Islamic Azad University, Iran

In this article, antibacterial film based on Low Density Polyethylene (LDPE), Potassium Sorbate (KS) and ethylene vinyl alcohol (EVOH) copolymer were prepared and characterized using Scanning Electron Microscopy (SEM), transmission electron microscopy (TEM), X-Ray Diffraction (XRD), Differential Scanning Calorimetry (DSC) and tensile tests. The oxygen barrier properties of the LDPE/EVOH/KS film were significantly better than those of the LDPE/KS film. In addition to barrier properties, the LDPE/EVOH/KS film also had better elastic modulus than their counterparts without EVOH. The antimicrobial film containing potassium sorbate decreased the growth rate and maximum growth of yeast and extended the lag period before mold growth was apparent. Therefore, it can prevent or reduce the rate of microbial spoilage in low viscosity liquids and on the contacted surface area of solid food products and as the result may prolong the shelf life of food products when it is used as a packaging material. Also, a novel sticker sensor has been fabricated based on methyl red and tests have been conducted to detect the freshness of meat by its color change in real time (when the red methyl red paper changed to yellow). These are prepared by entrapping within a pH sensitive dye that responds, through visible color changes to the spoilage volatile compounds that contribute to a quantity known as Total Volatile Basic Nitrogen (TVBN). Finally, the methyl red was successfully used as a sticker sensor for the real-time monitoring of meat freshness in ambient and chiller conditions.

Biography

Pouria Atabaki Pasdar has received Bachelor's degree in Polymer Engineering from the Islamic Azad University, Science and Research branch, Tehran, Iran and pursuing Masters in Polymer Engineering in the same university. His current research focuses on investigation of food packaging, bioplastics and nanotechnology in order to increase the shelf-life of food packages.

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Copper Based Multifunctional Nanocrystals for a Pragmatic Approach towards Cancer Theranostics**M. Sheikh Mohamed¹, Srivani Veeranarayanan¹, Aby Cheruvathoor Poulse¹, Toru Maekawa¹, D. Sakthi Kumar¹, Yasushi Sakamoto²**¹Bio Nano Electronics Research Centre, Toyo University, Japan²Biomedical Research Centre, Saitama Medical University, Japan

Multifunctional nanocrystals (NCs) for bio-applications are gaining momentum due to their advantageous role of performing multiple functions simultaneously. For example, NCs with simultaneous imaging and therapeutic potential are highly attractive as they can serve for image-guided therapy and can be considered for personalized cancer medicine. Especially Cu based NCs are garnering increased attention recently for their ease of preparation, biocompatibility and multimodal applications. Herein we present a series of plasmonically active Cu based NCs for cancer theranostics. The main features that would be discussed will be about multi-stimuli responsive chemotherapeutics as well as multimodal drug-free alternative theranostic options. The application of these NCs in diagnostic modalities such as photoacoustic, X-ray contrast, and optical (visible and NIR) imaging would be discussed. As far as therapeutic modality is concerned, chemo (external stimuli such as NIR and visible light responsive drug release), photothermal and photodynamic therapeutic options would be presented. The immense potential of these NCs cannot be undermined and they are sure to make a lasting impression in the nanomedicine/theranostics arena.

Biography

Dr. M. Sheikh Mohamed, currently a post-doctoral researcher at Bio-Nano Electronics Research Centre, Toyo University, Japan has nearly 8 years of research experience in the field of Bio-Nano Fusion Sciences, with a focus on synthesis and application of multifunctional nanoparticles for cancer theranostics. He has received best young researcher and best poster awards at International conferences and has published 15 peer-reviewed research articles with five cover pages in reputed journals, which have also been featured as news articles. Previously, he received the University Gold Medal during his M.Phil. in India and subsequently the prestigious Monbukagakusho Scholarship to pursue his Ph.D. in Japan.

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Cationic porphyrin induced B-Z transition of AT-rich DNA**Yun Jung Jang and Seog K Kim**

Yeungnam University, Republic of Korea

Cationic porphyrins interact with DNAs. Binding mode of porphyrins depends on various factors including nature of DNA sequences and the periphery substituents. Trans-bis(N-methylpyridium-4-yl) diphenyl porphyrin (trans-BMPyP) also bind to DNAs. Upon binding to poly[d(A-T)₂], typical circular dichroism (CD) spectrum in the DNA absorption region for B-form was reversed, suggesting formation of left-handed helical structure (Z-form). The formation of Z-form was confirmed by ³¹P NMR, in which a single ³¹P peak of B-form was split into two peaks, reflecting two distinctive environments for the DNA phosphate groups, which is typical for Z-form DNA. Trans-BMPyP-induce B-Z transition occurred specifically for polynucleotide having alternated AT sequences. No other combination of nucleobase sequence produced similar B-Z transition. This observation is in contrast with typical DNA sequence, alternating GC sequence (poly[d(G-C)₂]), that exhibits the B-Z transition. Cationic porphyrin has been known to intercalate between GC base pairs, while they stack along AT-rich DNAs. Pattern of stacking along DNA stem may be an important factor for this alternating AT sequence-specific B-Z transition. B-Z transition of alternating AT sequence requires at least 14 base-pairs, supporting the importance of porphyrin stacking along AT stem. The position of cationic ion on the periphery methyl pyridine ion also takes an essential role. When the methyl group locates at meta- or para-position, both cationic porphyrins similarly induce B-Z transition, while that at ortho-position, in which free-rotation of pyridine ring is sterically prevented, did not. This observation also indicated the importance of stacking of porphyrins along poly[d(A-T)₂] stem, because the former two porphyrins can be planar, therefore can stack each other. On the other hand, ortho-trans-BMPyP cannot be planar and stacking is inefficient.

Biography

Yun Jung Jang has her expertise in ligand-DNA interaction and synthesis of metal complexes that interact with DNA. She has her PhD degree at Daegu Catholic University and worked in Yeungnam University as a Research Assistant Professor in the DNA-drug interaction field. Presently, she is Assistant Professor in the College of Basic Education, Yeungnam University.

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Preparation of intelligence antibacterial films based on low density poly ethylene and evaluation of its properties**Pouria Atabaki Pasdar and B Bahari Aban**
Islamic Azad University, Iran

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Biography

Pouria Atabaki Pasdar has received his Bachelor's degree in Polymer Engineering from the Islamic Azad University, Science and Research branch, Tehran, Iran and presently pursuing Masters in Polymer Engineering from the same university. His current research focuses on investigation of food packaging, bioplastics and nanotechnology in order to increase the shelf-life of food packages.

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Response surface method optimization of rice straw-liquefaction using crude glycerol for rigid polyurethane foam application**Rosal Jane G Ruda, Kriztine M Icalina, Arnold A Lubguban and Canaveral**
Mindanao State University-Iligan Institute of Technology, Philippines

Polyurethane is a versatile class of polymer produced from the condensation polymerization of isocyanates and polyol, a hydroxyl-rich compound. Its application can be found in adhesives, sealants, coatings, flexible and rigid foams. However, polyol is traditionally sourced from petroleum raw materials. With increasing environmental and sustainability problems, lignocellulosic biomass is a potential alternative source due to its abundance, biodegradability and its hydroxyl component. In the Philippines, 11.3 M tons of rice straw is produced annually which when burned produces air pollutants such as carbon dioxide, nitrogen oxide and sulfur dioxide. Rice straw can be liquefied using an atmospheric liquefaction process with the use of a catalyst. Researchers reported that varying liquefaction parameters can significantly alter the properties of a polyol. The purpose of the study is to produce rice straw-based polyol with a low acid number, high OH number, low viscosity and high liquefaction ratio which are suitable for rigid foam applications. A one-pot liquefaction process was used to liquefy rice straw with the use of sulfuric acid as catalyst and crude glycerol as liquefaction solvent. Response surface methodology was used to optimize four factors: Acid loading, biomass loading, reaction time and reaction temperature based on four responses, acid number, OH number, liquefaction ratio and viscosity. Statistical analysis showed that all four factors have a significant effect on polyol properties. Increasing the acid loading was shown to significantly increase residual acid while higher reaction times lead to a decrease in liquefaction efficiency. Polyols with optimum properties were produced at a reaction time of 180-300 minutes, acid loading of 1-2%, reaction temperature of 170-180 °C and a biomass loading of 10-15%.

Biography

Rosal Jane G Ruda is currently pursuing Master of Science in Materials Science and Engineering at Mindanao State University-Iligan Institute of Technology. She is also working as a University Research Associate under Dr. Arnold A. Lubguban working in polymer research.

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Effects of rice straw-based polyol on the thermo physical properties of rigid polyurethane foam

Kriztine Magadan-Icalina, Rosal Jane M Ruda and Arnold A Lubguban

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Statement of the Problem: Vegetable oils and lignocellulosic biomass are two major types of bio-based resources gaining interest for bio-based polyols for Poly Urethane (PU) production. However, the consumption of huge amounts of vegetable oils could result in a shortage of vegetable oils and will cause the increase in food prices. Therefore, lignocellulosic biomass is seen as a better alternative raw material for PU production. Various kinds of lignocellulosic biomass have been used for the production of bio-based PU foams but the use of lignocellulosic rice straw is not yet explored. Thus, the study aims to develop PU rigid foam from rice straw-based polyol and investigate the effect of isocyanate index on the thermo physical properties of the foam.

Methodology & Theoretical Orientation: PU foams were prepared by reacting isocyanates in varying indices with polyols containing 15% of rice straw-based polyol and 85% petroleum-based polyol and their thermal conductivity, density and compressive strength were determined.

Findings: PU foams with no biopolyol replacement have superior thermal and mechanical properties over the PU foams with biopolyol replacement. However, those with biopolyol replacement were significant less dense compared to the commercial formulation. This could indicate possible application in industries where lightweight materials are important. Thermal characterization of the foam samples at different isocyanate indices indicate that increasing the isocyanate content improves insulation property of the PU as evident with the decreasing conductivity. This is also true with compressive strength. The index is directly proportional to the compressive strength. Density, on the other hand, is directly proportional to the isocyanate content.

Conclusion & Significance: Successful development of PU rigid foam products using biomass-based polyols obtained from a renewable feed stock rice straw offers a practical and economic procedure for potential scale-up and commercialization.

Biography

Kriztine Magadan-Icalina is a licensed Chemical Engineer and is currently pursuing her Master of Science in Material Science and Engineering in Mindanao State University, Iligan Institute of Technology.

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