

# “Functional Packaging through Chemistry”

October 29, 2008  
1:00 pm to 6:30 pm

Campus Center Atrium  
New Jersey Institute of Technology  
Newark, New Jersey

*Organized by NJACS Polymer Topical Group*

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**Organized by the NJACS Polymer Topical Group**

### **Symposium Organizers**

Dr. Tamal Ghosh (Organizer), Dr. Bin Wei (Co-organizer, Henkel), Dr. Ankur S. Kulshrestha (Co-organizer, BD Medical)

Dr. Bin Wei ( Posters Chair, Henkel) and Dr. Nicole Harris (Exhibits Chair, Sun Chemical)

- 12:00 noon **Registration**
- 1:00 PM **Welcome and Opening Remarks**
- 1:05 PM **Keynote Talk: *Challenges in sustainable packaging*** (Dr. Bob Kimmel, Clemson University)
- 2:05 PM ***Oxygen and moisture vapor barrier coatings*** (Dr. Derek Illsley, Sun Chemical, presented by Dr. Jeannette Truncellito)
- 2:35 PM ***Expanding the world of packaging applications for Ingeo™ biopolymers*** (Dr. Jim Nangeroni, NatureWorks)
- 3:05 PM **Poster Session and Networking**
- 3:35 PM ***The polymer supply chain and the impact on extractables and leachables in pharmaceutical container closure systems*** (Dr. Michael Ruberto, Ciba)
- 4:05 PM ***Aqueous Nanocomposite Barrier Coatings –An environmentally friendly platform for source reduction*** (Dr. Harris Goldberg, Inmat<sup>R</sup> Inc.)
- 4:35 PM ***Evolution of electronic packaging and its demands to materials*** (Dr. Allison Xiao, Henkel)
- 5:05 PM **Wrap up**
- 5:15 PM **Poster Session, Networking and Coffee**
- 6:15 PM **Drawing for Door Prizes**

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## **Challenges in Sustainable Packaging**

Dr. Robert M. Kimmel

Associate Professor and Chair, Department of Packaging Science

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### **ABSTRACT**

Sustainable packaging challenges us to design with the environment in mind, considering all phases of the product life cycle. Meeting this challenge requires us to optimize the use of renewable materials and energy and to protect the health of individuals and communities throughout the life cycle, to effectively recover and reuse materials and energy, and to accomplish these objectives while meeting market criteria for performance and cost. It has rapidly become apparent that meeting all of these criteria simultaneously is extremely difficult. Package designers and polymer scientists are therefore attacking individual pieces of the puzzle, thus evolving a range of alternatives from which approaches can be chosen to meet specific packaging situations. Source reduction is generally the most expedient solution to incremental improvements in sustainability. But many if not all the current developments in renewable and recoverable materials and energy rapidly run into the twin stumbling blocks of performance and cost. This is especially true as the current driving forces in the global market are pushing the limits of performance and demanding more functional packaging materials. End of life scenarios present additional challenges. On the one hand, infrastructure for successful composting of many biopolymers is sorely lacking, while on the other hand, recycling, especially into food packaging, raises the conflict between food safety and environmental protection. Equally frustrating is the lack of a universally accepted measure of environmental friendliness. This paper will review many of the traditional and emerging approaches to renewable and recoverable materials and try to evaluate them in the context of performance and cost. It will discuss the major forces driving improved and increased functionality and some of the latest technical responses. It will also highlight some of the major scientific issues challenging the chemical industry as we try to push forward the frontiers of sustainable packaging.

### **Biography of Presenter**

Dr. Robert M. Kimmel received B.S., M.S., Materials Engineer and Sc.D. degrees in Materials Engineering, all from the Massachusetts Institute of Technology. His research and education focused on fibers and polymers, with emphasis in Polymer Physics. Before coming to Clemson in Fall, 1999, Dr. Kimmel worked for over thirty years with the Hoechst Celanese Corporation. During his career, he had position responsibilities almost equally split among New Business Development, Sales and Marketing, and Research and Development. Over twenty years of this experience was in the packaging industries, in polyester film, polyester bottle resin and in the development of advanced, multi-layer barrier structures for flexible and rigid packaging applications. He lived and worked in Germany for three years and was heavily involved in two different joint ventures with Japanese companies. At Clemson he has developed and taught courses in polymers, flexible and rigid packaging, converting, and package design and development. He co-founded and directs the CU Center for Flexible Packaging. His research interests have included polymer blends, biopolymers, and applications of "smart blending" technology to packaging. He holds seven patents and has published numerous papers in polymers, fibers, and packaging. He has an active consulting practice as an expert in intellectual property litigation.

## **Oxygen and Moisture Vapor Barrier Coatings**

Dr. Derek Illsley  
Principal Scientist, Coatings Research  
Sun Chemical  
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### **Abstract**

Barrier coatings provide barriers to certain gasses, liquids, radiation or other substances. These may include oxygen, moisture vapour, aroma, water, light (including Ultra Violet) and in the case of food packaging applications, products, such as oils and fats etc. This presentation will concentrate on Oxygen and Moisture Vapour Barrier coatings applied to flexible packaging substrates. There is an ongoing requirement to improve barrier properties in order to extend shelf life of packaged foods. The ultimate barriers, Glass and tin, whilst infinitely recyclable are heavy and therefore expensive to transport which as a result means that CO<sub>2</sub> emissions are higher than for the transportation of comparatively light weight plastic packaging. Plastic packaging laminates, including aluminum foil barriers, whilst lighter than tin and glass render the packaging difficult if not impossible to recycle, resulting in the need to dispose of it in land fill or by incineration, both of which are negative options in a world where sustainability is of increasing importance. The gradual replacement of tin, glass and aluminum foils by plastic packaging materials has been evolving for several decades. The improvements to polymer film technologies coupled with inorganic and organic surface treatments and coatings continues to close the gap with tin and glass in terms of barrier performance, whilst ensuring that due attention is paid to the environment. In describing the various coating technologies, comparisons will be drawn with alternative methods of achieving these barriers, in order to provide a balanced view of this important property in relation to food packaging.

### **Biography of Presenter**

Derek is responsible for barrier coating developments within Sun Chemical's new Coatings Research initiative; mainly oxygen and moisture vapour barriers. Before starting his research into barrier coatings 4 years ago Derek's background was as a polymer chemist, with a breadth of experience covering principally radiation curable (free radical and cationic) and waterbased systems, with his work leading to the introduction of new technologies to the graphic arts industry.

Since gaining his PhD in 1990 at The University of Birmingham he has worked in the R&D arm of Coates Lorilleux and Sun Chemical. Through this time Derek has also co-supervised a range of PhD programmes at a number of UK Universities covering novel photoinitiators and photocurable chemistries, controlled radical polymerization, film formation mechanisms, synthesis of nanoparticles and intelligent polymer systems.

## **Expanding the World of Packaging Applications for Ingeo™ Biopolymers**

### **Dr. James F. Nangeroni**

Lead Applications Development Engineer  
NatureWorks, LLC  
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#### **Abstract**

A variety of world events are encouraging new innovations in the world of packaging when it comes to bioplastics. Since Ingeo™ biopolymers are the most widely available of this new generation of packaging materials; they are often the first choice of brand owners and converters when they are looking to make change in this direction.

The number of new applications is growing each month and is spurred by three factors. First, additive suppliers have introduced numerous products to the market that will improve some of the perceived deficiencies of the base polymers. Just like conventional plastics derived from petroleum sources, additives can improve impact strength, surface properties, heat resistance or just simply change the color. Second, there has been a wave of innovation at the converting and extrusion houses to make hybrid or composite structures that may not be 100% based on bioplastics, but may contain a significant portion of these materials without compromising product performance. And finally, a better understanding of the inherent strengths of the Ingeo™ family of products has allowed more focus in applications that are best suited to the base properties of the resin.

This presentation will highlight several of the new applications and the chemistry or technology that made them possible.

#### **Biography of Presenter**

Dr. Nangeroni is currently a Lead Applications Engineer at NatureWorks, LLC where his responsibilities include the development of new grades of NatureWorks Bio-polymer resins form new market opportunitites. During his 14 year tenure at NatureWorks, he has been instrumental in the development of grades for sheet extrusion, oriented film extrusion and currently foam.

Prior to joining NatureWorks, Jim was involved in the development of bio-polymers at both Novon Polymers and Air Products and Chemicals. He earned his doctorate in Chemical Engineering at the University of Delaware and his B.S. at Rensselaer Polytechnic Institute.

He served on the SPE Extrusion Board of Directors from 1988 until 2000 in various capacities including the Chairman and was the Technical Program Chair for the SPE ANTEC in Atlanta in 1997. This year, he was the recipient of the Distinguished Service Award from the Extrusion Division for his work in the society and the advancement of extrusion technology.

He as authored many technical papers on extrusion processing, new product development and polymer devolalization. He also holds more than a dozen patents covering formulation and processing of biopolymers.

## **The Polymer Supply Chain and the Impact on Extractables and Leachables in Pharmaceutical Container Closure Systems**

**Dr. Michael Ruberto**

Senior Consultant, Analytical Services

Ciba Expert Services

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### **Abstract**

The characterization and control of extractables and leachables in medical packaging and container closure systems is a formidable task for the pharmaceutical industry. Obtaining information from vendors regarding the composition of container closure system components can be a challenge, and even when this data is supplied, peaks corresponding to unknown components are often detected in chromatograms associated with extractable and leachable studies. The source of these unexpected migrants can often be traced back to the fabrication of the container closure system and are usually polymer additives that have unintentionally been added to the manufacturing process or degradation and transformation products that result from the active chemistry that occurs during the polymer processing. The secondary packaging, such as labels or bulk containers, has also been linked to introducing leachables into the drug product, including solid dosage forms. The goal of this presentation is to provide some background on polymer degradation and stabilization, as well as the subsequent impact on extractables and leachables. Critical points along the polymer supply chain will also be discussed as well as best practices for actively managing the supply chain by proactively communicating with vendors, selecting materials used to manufacture critical components, and chemically confirming the composition of container closure system components in the laboratory.

### **Biography of Presenter**

Dr. Michael Ruberto is currently a Senior Consultant for the Analytical Services Business of Ciba Expert Services. He was formerly the Head of Regulatory Services for the NAFTA region at Ciba Specialty Chemicals where he was responsible for world wide notifications of new products, food contact notifications, and regulatory compliance of Ciba chemicals. He is actively working in the area of designing leachable and extractable studies for the FDA approval of medical devices, packaging, and labels used on drug containers and is a member of the PQRI L&E Working Group. Dr. Ruberto was previously the Director of Analytical Research, where he led a full service analytical laboratory that specialized in performing testing associated with the development and commercialization of new products including chemical characterization, migration studies, applications support, and technical service. Dr. Ruberto has been employed by Ciba for fourteen years where he has performed numerous migration studies to support FDA and European Union indirect food contact notification for various additives, pigments, and polymers. He was part of a team commissioned to establish a Good Laboratory Practice (GLP) and Good Manufacturing Practices (GMP) program in Ciba's Analytical Research Department and served as GLP Study Director for many product characterization and Base Set studies needed for global product registration of novel additives. Dr. Ruberto received a B.S. with thesis from Stevens Institute of Technology and a Ph.D. in Analytical Chemistry from Seton Hall University.

## **Aqueous Nanocomposite Barrier Coatings –An Environmentally Friendly Platform for Source Reduction**

Dr. Harris A. Goldberg  
Inmat<sup>®</sup>, Inc.  
216 Route 206 Suite 7  
Hillsborough, NJ 08844  
[hagoldberg@inmat.com](mailto:hagoldberg@inmat.com)

### **Abstract**

InMat<sup>®</sup> has developed novel nanocomposite barrier coatings that are water based, contain no volatile organics or hazardous materials, and enable significant reductions in the material needed to achieve gas barrier requirements in a variety of products. Its current focus is on nanocomposite barrier coatings for food packaging providing an environmentally friendly approach that can significantly reduce amount of packaging material needed without compromising shelf life.

In this talk, the basic concepts behind InMat's technology platform will be described, and the performance of its barrier coating formulations presented.

### **Biography of Presenter**

Harris A. Goldberg received his Ph.D. in condensed matter theory from the University of Massachusetts in 1975. After a postdoc at the University of Toronto, he began an industrial research career at the Celanese Summit New Jersey research center in 1978. Working first for Celanese and later for Hoechst Celanese, he made technical contributions and led business development teams in numerous material science areas concentrating on organic based optical and electronic materials. He has over twenty patents, and has co-authored over forty technical papers as well as a book entitled *The Physics of Carbon and Graphite Fibers*.

In 1999, he co-founded InMat with his partner, Dr. Carrie Feeney. InMat leads the development of nanocomposite barrier coatings with its Nanolok<sup>™</sup> technology for use in packaging, sporting goods, automotive and chemical protection markets.

## **Evolution of Electronic Packaging and Its Demands to Materials**

Dr. Allison Xiao

Sr. Research Manager, Adhesive Research

Henkel Corporation

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### **Abstract**

The trend of the electronics industry, which requires products to be smaller, lighter, and less expensive, drives the advancement of the semiconductor packaging and surface assembly technology. Traditional wire bonding package provided limited I/O, thus the function of such package was bounded. Packaging is moving to multi-die structure from single die to enhance the functionality. Ball Grid Array (BGA) has become more adapted technology for surface assembly while the semiconductor industry is gradually adapting more flip chip technology using smaller sold ball joint to replace wire bonding technology. Flip chip technology enables high functionality in a smaller package size.

Current trend in the electronics industry is to use fast cure adhesives to save processing time and energy. Changing the flip chip package process is also an active direction not only because reducing the process time, but also helping to reduce energy consumption, thus reducing the total cost of the package. In this talk, the evolution of the flip chip packaging process including capillary, no flow, and wafer level process will be presented. The benefits of no flow and wafer level process will be discussed. Underfill materials are used to reinforce the chip package, which enhance the mechanical and electrical reliability of the flip chip package. Underfill materials also improve impact shock resistance and damping performance of the chip scale packages. The challenges to the new materials associated to the new processes will be presented as well.

Another way to reduce process and materials cost is to reuse the package. The density of the package on the assembly board becomes increasingly higher. Failure of one component could lead to discard of the entire board. Reworkability is becoming much desired feature when designing new packaging materials. The material challenge for the reworkable underfill materials will be presented. Material selection such as non-anhydride based underfill material, will be discussed. The new system eliminates the sensitizing issue by avoiding the use of epoxy anhydride.

New requirements of design and manufacturing processes, especially for passive materials present numerous challenges to the board assembly for reducing energy consumption and being environmental benign. Metal/ceramic based materials have been broadly used as passive components. However, high processing temperatures, (up to 800°C), make them very energy consuming and incompatible with organic-based substrates. In contrast, polymer-based materials, such as polymer thick films (PTFs), provide a wide range of electrical resistivity with reasonable curing temperatures. Tin-lead solder has been broadly use in the surface mount technology. With the drive towards lead free systems, polymer based conductive adhesive is being used as solder alternatives. The challenge on polymer based conductive and resistive materials will be presented.

### **Biography of Presenter**

Dr. Allison Xiao currently manages an adhesive research group at Henkel Corporation focusing on electronics materials and filler/particles research and development. Her experience covers a broad range of emerging electronics material technologies such as metal-filled conductive adhesives, carbon particle-filled printable integral resistor technology, printable conductive inks, novel underfill encapsulants, etc. She holds numerous patents on novel polymer materials for electronic applications and published over 20 papers and presentations in professional journals and international conferences. She is active committee member for ECTC and has been received YWCA Tribute to Women and Industry Award.

## Posters

	<b>Authors</b>	<b>Institution</b>	<b>Title</b>
<b>1</b>	Andrei Jitianu <sup>1,2*</sup> John P. Doyle <sup>2</sup> Glenn Amatucci <sup>2#</sup> Lisa C. Klein <sup>2</sup>	1 CUNY 2 Rutgers	Hybrid Organic-Inorganic Melting Gels and their Hermetic Barrier Properties
<b>2</b>	Carol Kam Courtney Cunningham Kevin Basile Anita J. Brandolini	Ramapo College of New Jersey	Adsorption of PMMA onto Various Inorganic Substrates
<b>3</b>	Haiyan Li Frieder Jäkle	Rutgers Newark	Fluorene-Based Organoboron Quinolate Polymers
<b>4</b>	Narmandakh M. Taylor Ralf M. Peetz	CUNY	Synthesis of amphiphilic membranes and their thermal and mechanical properties
<b>5</b>	Quyuan Zhou Marino Xanthos	NJIT	Hydrolytic Degradation of Polylactide Micro- and Nanocomposites
<b>6</b>	Ami Doshi Frieder Jäkle	Rutgers Newark	Synthesis and Characterization of Polystyrene Supported Borane Complexes PS-BH <sub>2</sub> •D
<b>7</b>	Chengzhong Cui Frieder Jäkle	Rutgers Newark	Organoboron block copolymers.
<b>8</b>	Brian Yan Peter Tattersall Jin Zhang	BMS	Evaluation and comparison of Evaporative Light Scattering Detector (ELSD), Charged Aerosol Detector (CAD) and Nano Quantity Analyte Detector (NQAD) for macromolecule analysis
<b>9</b>		Ciba	Solutions and Consulting for the Pharmaceutical and Medical Device Industries

# 1. Hybrid Organic-Inorganic Melting Gels and their Hermetic Barrier Properties

Andrei Jitianu<sup>1,2\*</sup>, John P. Doyle<sup>2</sup>, Glenn Amatucci<sup>2#</sup>, Lisa C. Klein<sup>2</sup>

<sup>1</sup>Lehman College, City University of New York, Department of Chemistry, Davis Hall, 250 Bedford Park Boulevard West, Bronx, New York 10468, USA

<sup>2</sup>Department of Materials Science and Engineering, # Energy Storage Group, Rutgers University 607 Taylor Road, Piscataway, NJ 08854, USA

Melting gels are organic-inorganic glasses that seal at temperatures lower than all-inorganic glasses and, unlike sol-gel glasses, are nonporous. Organically-modified silica melting gels prepared by the sol-gel method are rigid at room temperature, but soften and re-soften at temperatures in the range 100-120°C. After consolidation at around 135°C, the gels no longer re-soften.

Gels were prepared using methyltriethoxysilane (MTES) and dimethyldiethoxysilane (DMDES), with compositions between 50 MTES-50 DMDES and 75 MTES-25 DMDES mol%. Thermal gravimetric analysis and differential scanning calorimetry were performed, along with FTIR and Raman spectroscopic analyses. The surface area of the gels after their consolidation were confirmed by BET method to be less than 1 m<sup>2</sup>/g.

The barrier properties of the gels have been investigated using a helium leak test. The helium transmission rate was found to be  $\sim 8.6 \times 10^{-5}$  cm<sup>3</sup>/day. In addition, 5x5 cm<sup>2</sup> metal foil envelopes filled with common organic electrolytes were sealed with melting gel and stored for 4 weeks at 70°C. The measured weight loss after 4 weeks was less than 1%.

## 2. Adsorption of PMMA onto Various Inorganic Substrates

Carol Kam\*, Courtney Cunningham, Kevin Basile, and Anita J. Brandolini

School of Theoretical and Applied Science, Ramapo College of New Jersey

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Poly(methyl methacrylate) (PMMA) readily adsorbs onto many inorganic substrates through hydrogen-bonding of some of the pendant ester functionalities to surface features such as hydroxyl groups. The amount of adsorbed polymer and the ratio of bound to unbound carbonyls can be determined by lineshape analysis of infrared spectra. Most of our work has focused on different forms of silica (gel, fumed, nanopowder, etc.), but we have also investigated other types of inorganic materials (alumina, sulfates, phosphates, etc.).

### 3. Fluorene-Based Organoboron Quinolate Polymers

Haiyan Li and Frieder Jäk\*le\*

Organoboron polymers continue to attract most interest as optoelectronic materials with potential applications in organic light emitting devices, photovoltaics, and optical sensor components. Among them, organoboron quinolate polymers in particular represent a promising new class of light emitting materials, and noteworthy are their advantageous characteristics such as thermal stability, efficient luminescence and easy processability. We have prepared two types of luminescent fluorene-based organoboron quinolate polymers, **PFB2Q2** and **PFBQ**, by boron-induced ether cleavage reaction. **PFBQ** has a structure with quinolato substituted boron embedded in the main chain, while in **PFB2Q2**, both the quinolato moieties and the boron atoms are placed in the main chain. All the resulting polymers are readily soluble in common organic solvents and have been characterized by multinuclear NMR spectroscopy. They show good chemical stability and are thermally stable to >300 °C. The photoluminescence properties of **PFB2Q2** are strongly dependent on the conjugated bridge connecting the two quinolato groups. With a biphenyl linker yellow green emission was observed, whereas the Th-Ph-Th linker gave (weak) orange emission. The polymer with the Th-Ph-Th linker shows an unusual wavelength and concentration-dependent emission.

### 4. Synthesis of amphiphilic membranes and their thermal and mechanical properties

Narmandakh M. Taylor and Ralf M. Peetz

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The amphiphilic membranes ("smart" co-networks) of interest consist of hydrophobic and hydrophilic polymeric segments that are permanently crosslinked, forming a bicontinuous

phase. These networks have a cocontinuous hydrophilic-hydrophobic microstructure and therefore they swell both in water and in organic solvents [1-3].

According to literature [1-3], we have synthesized amphiphilic networks using commercially available polydimethylsiloxane (PDMS) as a hydrophobic segment, polyethylene-glycol (PEG) as a hydrophilic segment and the 2,4,6,8,10-pentamethylcyclopentasiloxane (D<sub>5</sub>H) as a crosslinker. We have analyzed amphiphilic networks' thermal and mechanical properties. Specifically, the mechanical properties of dry and water-swollen were investigated as a function of membrane composition.

The PEG/ D<sub>5</sub>H/ PDMS amphiphilic networks showed phase separation and it was very clear for conditioned and unconditioned samples. However, after conditioning the T<sub>m</sub> of PEG decreased as a function of molecular weight.

Distinct mechanical differences were observed when comparing dry samples with water-swollen specimen. Maintaining the fraction of PEG in the network (w%), but increasing PEG chain length, resulted in higher values with regard to elongation as well as strength.

TGA studies showed that all membranes showed two-stage thermal degradation: The first stage was observed from 250 °C to 350 °C due to PEG degradation, and the second stage at about 450-600 °C due to PDMS degradation.

#### References

- [1] J.P.Kennedy, K.S.Rosenthal and B.Kashibhatla *Designed monomers and polymers*, 7(2004) 485.
- [2] P.Kurian, B.Kashibhatla, J.Daum, C.A.Burns, M.Moosa, K.S.Rosenthal and J.P.Kennedy *Biomaterials*, 24 (2003), 3493
- [3] P.Kurian, J.P.Kennedy *J.Polym.Sci., Part A*, 40 (2002) 3093

### **5.Hydrolytic Degradation of Polylactide Micro- and Nanocomposites**

**Quyuan Zhou and Marino Xanthos**

#### **Abstract**

Poly(lactide) (PLA)-montmorillonite micro- and nanocomposites based on semicrystalline and amorphous polymers and unmodified and organomodified clays at 5wt% content were produced by melt mixing and subjected to accelerated hydrolytic degradation over a temperature range of 50°C-

70°C. Degradation rate constants were higher for amorphous PLA and its composites than for semicrystalline PLA and its composites as a result of increased permeation through the amorphous domains. Since the nanofiller's pH changed through treatment with organic chemicals, the degradation rate constants of the nanocomposites were significantly higher than those of the unfilled polymers; by contrast, those of the microcomposites were lower or slightly lower than those of the unfilled polymers possibly due to the reduction of the carboxyl group catalytic effect through neutralization with the hydrophilic alkaline filler. Although the degradation rate constants increased with increasing temperature from 50°C to 70°C, based on calculated activation energies the degradation kinetics did not differ significantly above and below the assumed  $T_g$  of 58°C~60°C. Higher activation energies were observed for the semicrystalline polymer and its composites. It was confirmed that bulk hydrolytic degradation starts from the interface between polymer and fillers for all samples; significant morphological differences between nanocomposites, microcomposites and unfilled polymer were observed.

## **6. Synthesis and Characterization of Polystyrene Supported Borane Complexes PS-BH<sub>2</sub>•D**

**Ami Doshi** and Frieder Jäkle,

Rutgers University, Newark, NJ

We have prepared polystyrene functionalized BH<sub>2</sub> polymers (PS-BH<sub>2</sub>) via post polymerization modification of poly(4-trimethylsilyl styrene). The polymer was successfully isolated in the form of its polymeric acid-base complexes PS-BH<sub>2</sub>•D (D = <sup>t</sup>BuPy, PPh<sub>2</sub>Me). Both polymers were fully characterized by multi-nuclear NMR spectroscopy and IR spectroscopy. Their thermal properties were studied by differential scanning calorimetry and thermogravimetric analysis. These polymers may find application as precursor to other functional polymers or as supported reducing agents.

### **7. Organoboron block copolymers.**

*Cui, Chengzhong*; Qin, Yang; Jakle, Frieder.

Department of Chemistry, Rutgers University-Newark, Newark, NJ, USA.

#### **Abstract**

Organoboron polymers continue to attract widespread interest due to their strong potential for use in diverse application fields, ranging from supported reagents and immobilized catalysts to separation media, sensors for anions and biological relevant molecules, and stimuli responsive polymers. In the area of materials chemistry they are known for their unique properties, including flame retardance and high thermal stability, and their use as preceramic materials, electrolytes for lithium ion battery applications, and optoelectronic materials. In comparison to purely organic polymeric materials, however, reports of organoboron block copolymer materials and their assembly properties are still rare. We describe here the preparation and solution self-assembly of several new classes of organoboron block copolymers containing anionic organoborate, cationic organoboronium, and pH sensitive boronic acid moieties, respectively.

### **8. Evaluation and comparison of Evaporative Light Scattering Detector (ELSD), Charged Aerosol Detector (CAD) and Nano Quantity Analyte Detector (NQAD) for macromolecule analysis**

**Brian Yan, Peter Tattersall and Jin Zhang**  
**Analytical Research & Development / New Brunswick**

#### **ABSTRACT:**

Different chromatography detectors allow for orthogonal analyses of materials. This can offer advantages in selectivity although different detectors have unique sensitivity and dynamic range. Polymer analysis tends to rely on Refractive Index Detectors, as they are somewhat universal, however they generally have poor sensitivity and for molecular weight distributions its signal to noise response can significantly affect the accuracy of the results. Here we have evaluated detectors that offer the possibility of a more sensitive response as well as a somewhat 'universal' selectivity. Evaporative Light Scattering Detector (ELSD) has historically been used in molecular weight distribution analysis of macromolecules. More recently Charged Aerosol Detector (CAD) that has been successfully used on small molecule analysis has been demonstrated to also work for macromolecular structures. Nano Quantity Analyte Detector (NQAD) is a more recent addition to the laser light / aerosol based family of detectors and this was also evaluated and its performance compared to the CAD / ELSD. The results and conclusions to this work demonstrate that these types of detectors can be applied to macromolecule weight distribution analysis with varying successes and limitations.

Exhibitor

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## **Candidate for Chairperson of NJACS Polymer Topical Group**

### **Professor Anita Brandolini**

#### **Statement:**

The recent rebirth of the Polymer Topical Group (PTG) has brought much-needed attention to polymer science in North Jersey. The collaborative way in which programs have been organized has ensured that both academic and industrial interests are served. As Topical Group Chair, I would, of course, continue to foster high-quality polymer programming in North Jersey. Furthermore, as an educator, I hope the PTG can also explore ways to stimulate interest in polymer science among students, particularly at the undergraduate level.

#### **Biography:**

Anita Brandolini is Assistant Professor of Chemistry at Ramapo College of New Jersey, where she teaches analytical chemistry. Her primary research focus is on the study of adsorbed polymers by infrared spectroscopy. Prior to joining Ramapo, she worked at Mobil Chemical's Edison, NJ research laboratory, where she led the analytical group and carried out NMR and IR analyses of polymers and polymerization catalysts. Brandolini is the author or co-author of over twenty book chapters and papers, mostly on the use of NMR to characterize polymeric systems. She has been active in the North Jersey Section of the ACS for many years. She holds a PhD from the University of Delaware (physical chemistry) and a BS (chemistry) from Drexel University.