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655th Conference

3rd International Conference and Exhibition on

Biopolymers & Bioplastics

September 12-14, 2016 San Antonio, USA

Keynote Forum

(Day 1)

Richard A Gross, J Bioremed Biodeg 2016, 7:5(Suppl)
http://dx.doi.org/10.4172/2155-6199.C1.001

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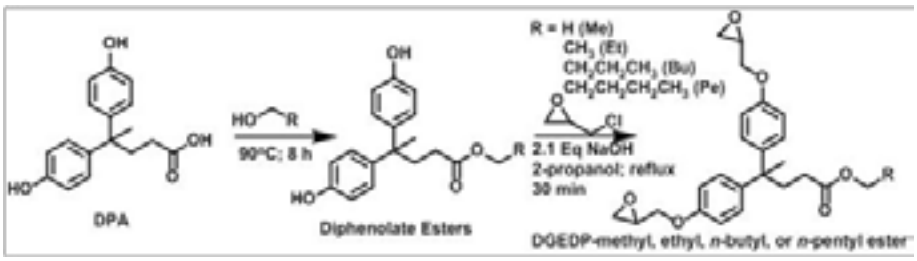
Richard A Gross

Rensselaer Polytechnic Institute, USA

Structure property relationships of biobased epoxy resins

Levulinic acid is produced from cellulose, the most abundant biomacromolecule on the planet, by the acid hydrolysis of cellulose and resulting C_6 sugars. Diphenolic acid (DPA) is synthesized by condensation of levulinic acid with two equivalents of phenol. A series of bio-based epoxy monomers were prepared from diphenolic acid (DPA) by transforming the free acid into n-alkyl esters and the phenolic hydroxyl groups into diglycidyl ethers. Increasing the chain length of DGEDP n-alkyl esters from methyl to n-pentyl resulted in large decreases in epoxy resin viscosity (700-to-11 Pa.s). The storage modulus of DPA epoxy resins, cured with isophorone diamine, also varied with n-alkyl ester chain length (e.g. 3300 and 2100 MPa for the methyl and n-pentyl esters). The Young's modulus and tensile strengths were about 1,150 and 40 MPa, respectively, for all the cured resins tested (including DGEBA) and varied little as a function of ester length. This work demonstrates that diglycidyl ethers of n-alkyl diphenolates represent a new family of bio-based liquid epoxy resins that, when cured, have similar properties to those from DGEBA. Combinations of DGEDP-Me, a rigid high viscosity biobased epoxy resin, and a flexible lower viscosity epoxy resin from cashew nut shell liquid (NC-514), provided control of the resin viscosity and important improvements in cured epoxy resin toughness relative to the neat resins. Relative to the neat high viscosity resin, 1:1 w/w mixtures of the rigid and flexible epoxy resin components gave increases in the impact strength and mode I fracture toughness of 136% and 66%, respectively. The monofunctional glycidyl ether of eugenol (GE) was used as a reactive diluent for the diglycidyl ether of DGEDP-Pe. Viscosities of GE and DGEDP-Pe are 25 MPa.s and 11 Pa.s, respectively. GE/DGEDP-Pe epoxy resins with 5, 10, 15, 20, and 30 wt % GE were analyzed for viscosity reductions, and, subsequently, cured with isophorone diamine. The glassy modulus of cured GE/DGEDP-Pe epoxy resins remained between 2000 and 3000 MPa. The role of GE as a reactive diluent will be discussed and a 15% loading was determined to be suitable for a vacuum infusion epoxy resin/glass composite system.



Biography

Richard A Gross is currently a Full Professor and a Constellation Chaired Professor at Rensselaer Polytechnic Institute (RPI). His research is focused on developing biocatalytic routes to biobased materials including monomers, macromers, prepolymers, polymers, surfactants and other biochemicals. He has over 500 publications in peer reviewed journals, been cited about 18,000 times (h-index 71), edited 7 books and has 26 patents (granted or filed). He was the recipient of the 2003 Presidential Green Chemistry Award in the academic category. In 2010, he was selected as the Turner Alfrey Visiting Professor, and in 2015 he became a Fellow of the ACS Polymer Division. He founded SyntheZyme LLC in 2009 and serves as CTO.

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Dean C Webster

North Dakota State University, USA

Bio-based thermosets from star-like highly functional reactive resins

A challenge faced with transitioning from polymer materials derived from petrochemical sources to bio-based sources is in designing materials having the performance properties required for today's applications. High performance thermoset polymers are used in applications such as coatings, composites, and adhesives and are made in-situ from the reactions of functional low molecular weight resins or functional oligomers. While vegetable oils are a readily available and amenable to functionalization to be used in thermosets, their long aliphatic hydrocarbon chains tend to result in materials that are soft and flexible. However, we have found that by creating multifunctional resins from vegetable oil fatty acids and a highly functional polyol, thermosets can be formed that have the strength and stiffness for use in high performance coatings and composites. For example, epoxidized sucrose esters crosslinked with cyclic anhydrides yield thermosets having modulus values exceeding 1 GPa. Polyurethanes made using highly functional soy polyols have glass transition temperatures exceeding 100°C, much higher than typical soy-based polyols. Methacrylated sucrose esters can be used to form high performance composites using either glass or natural fibers. It has also been discovered that 100% bio-based thermosets can be made from the water-catalyzed crosslinking of epoxidized sucrose soyate with naturally-occurring acids.

Biography

Dean C Webster is Professor and Chair in the Department of Coatings and Polymeric Materials at North Dakota State University (NDSU). He received a BS in Chemistry and a PhD in Materials Engineering Science both from Virginia Tech. Prior to joining NDSU in 2001, he worked for Sherwin-Williams and at Eastman Chemical Company. He is the recipient of the 2011 Roy W Tess Award in Coatings Science given by the American Chemical Society, the 2013 Joesph Mattiello Lecture award given by the American Coatings Association, and the Waldron Research Award given by the NDSU Alumni Association. His research is in the area of new high performance polymer systems for coatings and composites, nanocomposites, polymers for marine antifouling coatings, and use of renewable resources in polymers and coatings systems.

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Amar Kumar Mohanty

University of Guelph, Canada

Circular economy and sustainability of bioplastics and biobased materials: New challenges and future prospective

Renewable resource-based nature of bioplastics and biobased materials is not enough in bringing these emerging bioproducts to market place for societal benefit. Circular economy is a concept that targets waste minimization through a closed loop system thereby helping a sustainable development. The co-product and byproduct of one industry can find value-added uses if appropriately integrated in the design and engineering of biobased materials of commercial attraction. Bioplastic as such may be comparatively expensive as compared to traditional and petro-based plastics. An undervalued co-product of one industry can be integrated into a bioplastic in creating novel biobased materials for new industrial uses. The coproducts from biofuel, pyrolysis as well as food processing industries show immense potential as fillers or reinforcing materials for plastics in creating a range of eco-friendly and sustainable biocomposites. This presentation will provide an overview on the recent development of these biobased composite materials for industrial uses in green packaging, consumer products and light weight auto-parts.

Biography

Dr. Amar K Mohanty, a Full Professor and Premier's Research Chair in Biomaterials and Transportation is the Director of Bioproducts Discovery & Development Centre at University of Guelph, Ontario, Canada. He is an international leader in the field of bioplastics, biobased materials and advanced biorefining with a focus in engineering new sustainable materials. He has more than 500 publications to his credit including 260 peer-reviewed journal papers, 25 patents (granted/filed), several conference presentation, 15 book chapters and three edited books - his total citations being 13,827 with h-index of 56. He was the recipient of the Andrew Chase Forest Products Division Award from the American Institute of Chemical Engineers (AIChE) and Jim Hammer Memorial Service Award from the BioEnvironmental Polymer Society. His R&D excellence has helped in developing a number of industrial products and recently his research innovations have brought three biobased products to the market place.

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Keynote Forum

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Etienne Grau

University of Bordeaux-CNRS-Bordeaux INP, France

Fully bio-based non-isocyanate polyurethanes (NIPU) via cyclic carbonate/amine route

Thermoplastic poly(hydroxyurethane)s (PHUs) raised industrial and academic research curiosity, since their synthesis is achieved via the ring-opening of bis-cyclic carbonates with diamines, enabling the replacement of phosgene and isocyanates employed in the classical polyurethane (PU) manufacture. Due to fossil fuel depletion and environmental concerns, the use of building-blocks from renewable resources is highly investigated. Combining PHUs synthesis and bio-based compounds, a large platform of fatty acid-based cyclic carbonates as poly(hydroxyurethane) precursors was synthesized by epoxidation/carbonation routes. However, such monomers exhibited a slow polymerization rate towards amines, due to the electron-releasing alkyl chains, which deactivate the cyclic carbonates. An alternative route consists in inserting a heteroatom nearby the cyclic carbonate to improve/activate its reactivity. Herein, the synthesis of new activated lipidic cyclic carbonates from glycerol carbonate and epichlorohydrin has been achieved, leading respectively to an ester or an ether linkage in β position of the carbonate. After kinetic investigations of the cyclic carbonate aminolysis on model compounds, the corresponding activated bis-cyclic carbonates were polymerized with two diamines and exhibited enhanced reactivities. A specific focus on the side reactions that could occur in both model reaction and polymerization is also discussed. On the other hand, a new route to access bio-based diamines using mild and green conditions has been set up through an optimization of aliphatic alcohol oxidation into the corresponding nitriles, followed by an hydrogenation. The resulting diamines were subsequently polymerized with activated cyclic carbonates in order to obtain fully bio-based poly(hydroxy urethane)s.

Biography

Etienne Grau was trained in chemistry and physical chemistry at the ENS Cachan (France) and then undertook a PhD in polymer chemistry at CPE Lyon (France), where he studied the radical and catalytic polymerization of ethylene and its copolymerization with polar monomers in the C2P2 laboratory under the supervision of Dr. Vincent Monteil, Dr. Christophe Boisson and Dr. Roger Spitz (2007-2010). During a first post-doctoral stay, he studied Ziegler-Natta catalysis merging theoretical (with Prof. Phillipe Sautet at the ENS Lyon), surface (Prof. Christophe Copéret at ETH Zurich) and polymer chemistry (with Dr. Vincent Monteil at C2P2). Then in 2012, he moved to the group of Prof. Stefan Mecking in Konstanz (Germany) to work on Pd catalysis of the synthesis of monomers from lipids and terpenes. He was recruited by LCPO in 2013 as Assistant Professor in the group of Prof. Henri Cramail for his expertise in polymer chemistry and catalysis. He published around 30 articles and 10 patents. He received the best 2011 thesis prize of the French polymer group (GFP).

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David Grewell

Iowa State University, USA

Sustainable plastics and the center for bioplastics and biocomposites

In this presentation, we review the basic concepts and history of bioplastics and biocomposites. We then provide an overview of the current state of the field. While there have been many early developments in bioplastics and examples of biocomposites in the last 60 years, today this technology has gained increased interest with many applications, and there are new products and materials under development and commercialization. The National Science Foundation (NSF) has recently funded an Industry/University Cooperative Research Center (I/UCRC) focused on bioplastics. Designated as the Center for Bioplastics and Biocomposites (CB^2), this center is led by Iowa State University and Washington State University. The thrust of this new NSF center will be reviewed along with the center's benefits to the bioplastics and biocomposites industry.

Biography

David Grewell completed his BS, MS and PhD in Industrial Systems and Welding Engineering from The Ohio State University. He holds 14 patents and has been given numerous honors and awards as well as numerous publications, including two books. His interests include "Joining of plastics, micro-fabrication, laser processing of materials, bioplastics and biofuels". He currently works at Iowa State University as a Professor in the Department of Agricultural and Biosystems Engineering. He is the Director of the NSF Center for Bioplastics and Biocomposites, is the Chair of the Biopolymers & Biocomposites Research Team, a Board Member of the Ultrasonic Industry Association, Society of Plastics Industry and Society of Plastics Engineers. He also has a position at the University of Erlangen in Germany and is Fellow of the Society of Plastics Engineers.

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Keynote Forum

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Ramani Narayan

Michigan State University, USA

Understanding biodegradability – The science, the misuse and true value proposition

Design for product biodegradability in conjunction with controlled, managed disposal systems like composting or anaerobic digestion can offer an environmentally responsible end-of-life value proposition. However, much confusion, misuse and misleading claims abound in the market place. This lecture will discuss the science and issues surrounding biodegradability – what does the claim "biodegradable" mean? What value does biodegradability as an end-of-life solution offer? Should an unqualified claim of "biodegradable" without any reference to time element, rate and disposal environment be permitted? Are such statements truthful or misleading? Is "marine biodegradability" a solution or exacerbate the problem of plastics waste in the ocean. We will discuss these issues on a science basis and review the International Standards and regulations in this space as well as learn accurate reporting and communication of "biodegradable" value attribute.

Biography

Ramani Narayan is University Distinguished Professor, the highest honor that can be bestowed on a faculty member at Michigan State University. He is Fellow of the US National Academy of Inventors; Fellow of ASTM & received ASTM award of merit, the highest award given by the society to an individual member. He is Scientific Chair of the Biodegradable Products Institute (BPI) USA; and Convener/Technical Expert on several ISO Standards committees. He has 200 refereed publications, 30 issued patents and supervised 20 PhD and 25 Master's students. He is a successful Entrepreneur, having commercialized several bioplastics technologies.

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