FINAL PROGRAM
NINTH INTERNATIONAL SYMPOSIUM ON

POLYMER SURFACE MODIFICATION

RELEVANCE TO ADHESION:

To be held June 17-18, 2013 in collaboration with the

Center for Polymer Science and Engineering, Lehigh University, Bethlehem, Pennsylvania, USA

SYMPOSIUM HISTORY AND MOTIVIATION

This symposium ninth in the series which continues the tradition set by the first in the series entitled: "Polymer Surface Modification: Relevance to Adhesion" which was held in Las Vegas, NV, 1993. As with its predecessors, this symposium will be concerned with the technological areas where surface modification is a key technology which allows for the processing and manufacture of products which would otherwise be unobtainable.

Proper adhesion characteristics are vital to the success of any practical implementation of polymer materials. Though polymers are generally not very adhesionable, careful surface modification can result in greatly improved adhesion without altering bulk properties.

AUDIENCE AND PARTICIPATION

This symposium is organized to bring together scientists, technologists and engineers interested in all aspects of polymer surface modification, to review and assess the current state of knowledge, to provide a forum for exchange and cross-fertilization of ideas, and to define problem areas which need intensified efforts.

INQUIRIES AND SYMPOSIUM DETAILS

This symposium is being organized by MST Conferences under the direction of Dr. K. L. Mittal, Editor Reviews of Adhesion and Adhesives. Questions concerning symposium details such as on campus housing, travel details, parking or changes in the program should be addressed to the conference chairman below:

E-mail: rhl@mstconf.com
FAX: 212-656-1016
Regular mail:

Dr. Robert H. Lacombe
Conference Chairman
3 Hammer Drive
Hopewell Junction, NY 12533, USA

Contact by phone: 845-897-1654; 845-227-7026
Symposium cell phone: 845-260-8873; Activated starting June 16, 2013

Full conference details and registration via the Internet will be maintained on our web site:

http://mstconf.com/surfmod9.htm

ONLINE RESPONSE FORM: www.mstconf.com/resp-sprg-2013.htm

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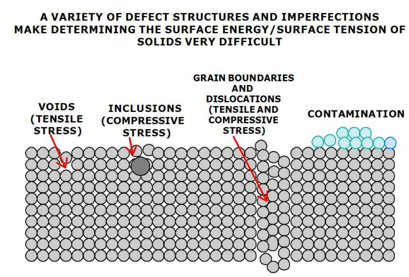

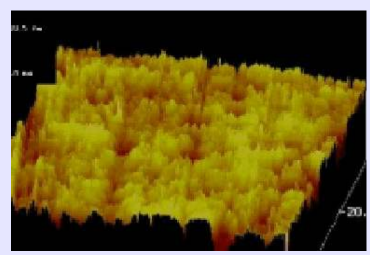

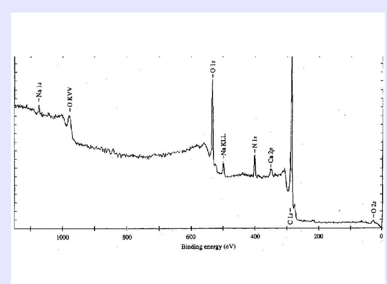

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While at the symposium you can also enjoy a number of the attractions of the Lehigh University campus. Further details are available on the campus website at

www.lehigh.edu

SESSION I: MONDAY, JUNE 17, 2013 (Click on highlighted author name to go to full abstract)

8:30: INTRODUCTORY REMARKS

8:35-9:15: Stephen L. Kaplan; 1260 Elmer Street, Belmont, CA 94002; The Best Kept Secret in Industry

9:15-9:45: J. Dutroncy, E.Jouvet and T.Sindzingre; AcXys Technologies, 148 rue des vingt Toises, 38950 St Martin le Vinoux, FRANCE; Atmospheric Pressure Plasma, Competitive and Efficient as a One-step Surface Preparation

9:45-10:15: Zac MacKay and Andy F. Stecher; Plasmatreat North America, 1480 Sandhill Dr. Unit 8, Ancaster, ON, CANADA L9G 4V5; Openair® Plasma Improves Adhesion of LSR to Medical Grade Polymer Substrate Materials

10:15-10:30: COFFEE BREAK

10:30-11:00: Robert F. Hicks; Chemical Engineering and Materials Science, University of California, Los Angeles, CA; Surface Preparation of Polymer Composites for Adhesion Using Atmospheric Pressure, Capacitive Discharge Plasmas

11:00-1130: Jihye Lee and Yeonhee Lee; Advanced Analysis Center, Korea Institute of Science and Technology, Seoul 136-791, KOREA; Surface and Interface Modification of Polymeric Materials by Various Plasma Techniques

11:30-12:00: Hernando S. Salapare III and Henry J. Ramos; Plasma Physics Laboratory, National Institute of Physics, College of Science, University of the Philippines Diliman, Quezon City 1101, PHILIPPINES; Surface Modification of Poly(tetrafluoroethylene) (PTFE) Materials via Low-energy H_2, O_2, Ar, and CF_4 Ion Shower Treatments Using the Gas Discharge Ion Source Facility

12:00-2:00: LUNCH

SESSION II: MONDAY, JUNE 17, 2013

2:00-2:30: Brian J. Meenan; Nanotechnology and Integrated Bioengineering Centre (NIBEC), School of Engineering, University of Ulster, Newtownabbey, Northern IRELAND, BT37 0QB; Directing the Biological Response to Polymeric Biomaterials Using Atmospheric Pressure Plasma Modification Strategies

2:30-3:00: Liam O'Neill; Triton Systems Inc, IRELAND; Improving Adhesion on Polymer Surfaces Through Plasma Enhanced Coating Deposition

3:00-3:30: Siyuan Ma; Materials Eng. Program, State University of New York at Binghamton, Microflow Laboratory, Mechanical Engineering Dept., 85 Murray Hill Rd., Vestal, NY 13850; The Plasma Post-Deposition Process for Inkjet Manufactuiring

3:30:-3:45: COFFEE BREAK

3:45-4:15: Luc Stafford; Department of Physics, University of Montreal, Montreal, Quebec H3C 3J7, CANADA; Growth of Nanocomposites on Heat-sensitive Polymers Using Cold, Atmospheric-pressure Plasmas

4:15-4:45: L. Oliveira, F. Lu, L. Andrews, M. Mehan, T. Debies and G. A. Takacs; School of Chemistry and Materials Science, Rochester Institute of Technology, Rochester, NY 14623; UV Photo-Chlorination and -Bromination of Single-walled Carbon Nanotubes

SESSION III: TUESDAY, JUNE 18, 2013

8:30-9:00: B. Riedl, V. Vardanyan, A. Kaboorani, B. Poaty and G. Chauve; Département des sciences du bois et de la forêt, faculté de géomatique, géographie et foresterie, Centre de recherche sur le bois, Université Laval, Québec, Canada G1K 7P4; Modified Nanocellulose for Composite Coatings

9:00-9:30: Alireza Kaboorani and Bernard Riedl; Département des sciences du bois et de la forêt, Faculté de foresterie, de géographie et de géomatique, Université Laval, 2425, rue de la Terrasse, Québec, QC, G1V 0A6 , CANADA; Surface Characterization of Modified Nanocrystalline Cellulose (NCC)

9:30-10:00: Raymond A Pearson and Sepideh Khoee; Materials Research Center, Lehigh Unversity, Bethlehem, PA; Epoxy Modified with Block Copolymers: the Role of Bondline Thickness on Adhesive Strength

10:00-10:30: COFFEE BREAK

10:30-11:00: M. Masudul Hassan , Marco Mueller and Manfred H. Wagner; Department of Chemistry, M C College, National University, Sylhet-3100, BANGLADESH; Bio-Fiber Reinforced Polymer Composite: Role of Compatibilizer

11:00-11:30: Ahmed Abou-Kandil , Nabila Darwish , Adel Shehata, Samir Lawandy, Anhar Awad and Basma Saleh; National Institute of Standards, Tersa Street, El-Haram, El-Giza, P.O. Box 136, Giza 12211, EGYPT; Promoting Adhesion of Natural Rubber to Brass Plated Steel Cords

11:30-12:00: Dounya Baritt, Houda Ennaceri, Ahmed Ennaoui, Adil Chaboun and Asmae Khaldoun; Al Akhawayn University School of Science and Engineering, MOROCCO; Nanocoating and Testing; A Step Towards the Improvement of CSP Reflectors for Less Intensive Maintenance Both in Terms of Labor and Water

ABSTRACTS

Stephen L. Kaplan; 1260 Elmer Street, Belmont, CA 94002

The Best Kept Secret in Industry

Five decades ago there were few green choices to modify polymer surfaces; there were only corona and flame. In the 60's cold gas plasma was introduced as a work place, environmentally safe and particularly effective method to modify polymers for enhanced adhesion. Plasma's superiority quickly became obvious and corona and flame manufacturers adopted the term "plasma" for their processes and then confusion reigned. While it is true that corona and flame are "plasmas" the energetic species present in corona and flame plasma have significantly less energy than present in a cold gas plasma, aka low pressure plasma, thus are very limited in the chemical changes they can effect. Scientific journals fail to adequately discern between the plasmas processes in their published papers thus Material Engineers often miss the subtle differences in such learned papers and assume the limitations discussed for coronas, atmospheric plasma and flames are not necessarily applicable to cold gas plasma. One of the best kept secrets is the utility of cold gas plasma to successfully graft silanes to the surfaces of metals, ceramics and polymers. This paper will discuss several examples of plasma silanization processes.

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J. Dutroncy, E.Jouvet and T.Sindzingre; AcXys Technologies, 148 rue des vingt Toises, 38950 St Martin le Vinoux FRANCE; www.acxys.com

Atmospheric Pressure Plasma, Competitive and Efficient as a One-step Surface Preparation

Since early 2000, Atmospheric Pressure plasma (APP) sources are heading more and more interests for industrial applications. These plasmas demonstrated to be clean and efficient solutions towards the industrial needs in surface treatments and adhesion enhancement.
These industrial developments tend nowadays to open new alternative solutions for surface treatments on a very large panel of materials and products. In the following, plasma's conditions of applications will be discussed and new studies and developments presented.

Different strategies for adhesion enhancement by plasma treatments

Two different technologies are presently offered by AcXys, the so called “Ultra Light (UL)”. These devices designed and described as complementary plasma sources, allowing slow or fast treatments or more or less large surfaces.

ULS (plasma plume) ULD(plasma curtain)

Industrially innovative, AcXys is always dedicating effort on better plasma applications on surfaces, multiplying the controlled treatment parameters. Examples would be presented.

Processing on polymers and rubbers: from simple processing to more complex chemical treatments

Reaching industrial needs for surface preparation most of the time requires easy and economically adapted equipments. APP is characterized by its capacity of providing a dry and clean alternative to chemical approaches.
Atmospheric plasmas have been used as an alternative solution for different processes steps like cleaning, activating or functionnalizations.
Recent concrete examples on which plasma can compete against liquid

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Zac MacKay[1] and Andy F. Stecher[2]

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2) Plasmatreat North America, 2541 Technology Dr., Suite 407Elgin, IL 60124

Openair® Plasma Improves Adhesion of LSR to Medical Grade Polymer Substrate Materials

As the choice of materials available for injection molding increases, so too does the desire to pair these materials in multi-shot molding processes. This has given rise to increased issues with adhesion between dissimilar materials that older techniques cannot satisfy. Atmospheric pressure plasma has emerged as a powerful tool to allow strong chemical bonding for in-mold processes. Liquid Silicone Rubber has long been one of the greatest challenges and plasma has opened the doors to new bonding possibilities.

In this session we will discuss how plasma can be used in-mold to remove contamination and functionalize the surface of various polymers for adhesion of LSR. Traditional options will be looked at and compared to this new State-of-the-Art which allows for optimal adhesion and enviro-conscious manufacturing.

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Robert F. Hicks; Chemical Engineering and Materials Science, University of California, Los Angeles, CA

Surface Preparation of Polymer Composites for Adhesion Using Atmospheric Pressure, Capacitive Discharge Plasmas

Carbon-fiber-reinforced composites have replaced aluminum and titanium in most of the structural components of modern aircraft. If the composite structures are joined together using adhesives instead of fasteners, then the overall cost to manufacture the aircraft may be reduced by about 40%. However, adhesive joints are unreliable due to the reliance on manual abrasion techniques to prepare the polymer surface for joining. An alternative approach is automated surface preparation using atmospheric pressure plasmas. In this presentation, we will examine the effect of oxygen plasma treatment on the surface chemistry and mechanical properties of adhesively joined epoxy composites. Lap shear results have demonstrated an increase in bond strength of 150% to 300%, following plasma activation. Wedge crack extension tests have revealed that plasma-activated laminates exhibit >95% cohesive failure compared to <70% for the untreated controls. Surface analysis by x-ray photoelectron spectroscopy has indicated that carbonaceous contamination is removed by plasma exposure, and specific functional groups, e.g. carboxylic acids, are formed on the polymer surface. These functional groups are crucial to promoting strong chemical bonding between the film adhesive and the epoxy composite. In summary, atmospheric pressure, capacitive discharge plasmas are an attractive alternative to abrasion for surface preparation of composites used by the aerospace industry.

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Jihye Lee and Yeonhee Lee; Advanced Analysis Center, Korea Institute of Science and Technology, Seoul 136-791, KOREA

Surface and Interface Modification of Polymeric Materials by Various Plasma Techniques

Various plasma sources are widely used in surface modification technologies for altering the surface properties of materials. Plasma and ion implantation treatment can be used to remove the contaminants on the surface, form the polar functional groups and change the surface roughness for the surface modification of materials. Our group investigated the use of plasma source in the modification of polymeric materials. Plasma source ion implantation (PSII) technique was used for the ion implantation and deposition of copper film on the polyimide. In PSII-EIAMAD (energetic ion assisted mixing and deposition) process, a polyimide film was immersed in a plasma, and high negative voltage pulses were applied to accelerate ions into the substrate resulting in the mixing effect of copper atoms with polyimide layers. This method was used to improve the adhesion between Cu layer and polyimide film. The adhesion strength was determined by the 90° peel test. Cu surface was investigated by SEM and AFM, and the interface between Cu film and polyimide was characterized by AES. We also fabricated fluorine-containing plasma polymer films using five different plasma methods. ; inductively coupled plasma (ICP), pulsed-plasma (PP), capacitively coupled plasma (CCP), self-ignition plasma (SIP), and PSII/ICP. F-containing polymers produced by five processes have different properties. The properties of the plasma polymers, hydrophobicity, binding structure and chemical composition, were investigated by water contact angle, FE-SEM, AFM, XPS, TOF-SIMS and NEXAFS measurements.

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Hernando S. Salapare III[1,2,*] and Henry J. Ramos[1]

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Surface Modification of Poly(tetrafluoroethylene) (PTFE) Materials via Low-energy H_2, O_2, Ar, and CF_4 Ion Shower Treatments Using the Gas Discharge Ion Source Facility

Poly(tetrafluorethylene) (PTFE) surfaces were modified by low-energy H_2, O_2, Ar, and CF_4 ion shower treatments using the gas discharge ion source facility. The modified surfaces were evaluated using contact angle, surface morphology (scanning electron microscopy), and surface chemistry (Fourier transform infrared spectroscopy) characterizations. The wettability of the PTFE samples were altered from being hydrophobic to become either hydrophilic or superhydrophobic depending on the plasma energy and the type of gas employed. The changes in the wettability of the modified PTFE were also found to be caused by (1) the changes in the roughness of the surface, (2) the formation of nanoparticles or nanostructures on the surface, and (3) the changes in the surface chemistry.

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Brian J. Meenan; Nanotechnology and Integrated Bioengineering Centre (NIBEC), School of Engineering, University of Ulster, Newtownabbey, Northern IRELAND, BT37 0QB

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Directing the Biological Response to Polymeric Biomaterials Using Atmospheric Pressure Plasma Modification Strategies

The development of biomaterials with improved functionality is critical for the provision of the next generation of medical technologies and associated clinical therapies. Many such devices are specifically required to promote the restoration and/or repair of body tissue function *in vivo*. As such, a detailed understanding of those factors that influence the quality of the interface created between a device/biomaterial and the biological system is crucial. This is particularly the case for polymeric biomaterials which are bioinert in the pristine state.

It is well established that specific surface cues can direct and control key protein and cellular processes that occur at the interface between a biomaterial and the host tissue. An appropriate combination of chemistry and topography is important for the formation of viable tissues. Hence, targeted modification of polymer surfaces offers the means to create features capable of eliciting the required substrate responses when in contact with cells and other biological species.

This presentation reports results from a range of surface engineering strategies that utilise atmospheric pressure plasma processing to provide active chemistries and surface topographical features capable of promoting cell adhesion and directing the associated bioresponse on a range of important polymeric biomaterials including PS, PMMA, PEEK Cellulose and PCL. Both direct modification and plasma enhanced grafting of macromolecules such as polyethylene glycol, collagen and hyaluronic acid have been successfully employed to direct protein and cell interactions on polymer films and electrospun matrices. The important role that surface analysis plays in confirming and quantifying the required chemical and topographical functionality is highlighted throughout. Likewise, the choice of cell culture model and associated bioassays is considered.

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Liam O'Neill; Irish Surface Engineering, 22 Summerhill North Cork, IRELAND

Improving Adhesion on Polymer Surfaces Through Plasma Enhanced Coating Deposition

Adhesion and joining of plastics can be problematic and numerous different adhesives, chemical primers and surface treatments are employed to try and overcome the inherent lack of adhesion in many polymers. Although a simple plasma treatment can improve the adhesion on some polymeric materials, the final adhesion is still strongly controlled by the chemistry of the substrate and there is still room for improvement for many materials. Herein we report on an ambient pressure, low temperature plasma treatment which alters the surface chemistry of the substrate by depositing an adherent chemical primer layer. This process combines the benefit of plasma activation with that of a chemical primer to produce enhanced adhesion on a range of surfaces. This method has been evaluated on a variety of materials and the improvements have been shown to be greater than that achieved by simple plasma activation alone. In addition, the plasma deposited primer layer has been shown to produce joints that are stable under dry or humid conditions and have not been degraded by prolonged immersion in hot water.

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Siyuan Ma; Materials Eng. Program, State University of New York at Binghamton, Microflow Laboratory, Mechanical Engineering Dept., 85 Murray Hill Rd., Vestal, NY 13850

The Plasma Post-Deposition Process for Inkjet Manufactuiring

(Abstract not yet available)

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Luc Stafford; Department of Physics, University of Montreal, Montreal, Quebec H3C 3J7, CANADA

Growth of Nanocomposites on Heat-sensitive Polymers Using Cold, Atmospheric-pressure Plasmas

Cold, atmospheric-pressure plasmas have already demonstrated their potential for homogeneous thin film deposition in polymers functionalization. In order to achieve multifunctional properties, a new challenge is the plasma-assisted deposition of nanocomposite coatings. This contribution is focused on the growth of nanocomposites based on TiO_2 nanoparticles embedded in a silica-like matrix with the objective of synthesizing oxygen barrier layers with improved resistance to UV irradiation. Experiments were carried out in a parallel plate dielectric barrier discharge with the substrate placed on the bottom electrode. The gas mixture is composed of N_2 as the carrier gas, a mixture of hexamethyldisiloxane and nitrous oxide for the growth of the SiO_2 matrix, and TiO_2 nanoparticles which are introduced by nebulizing stable colloidal solutions. Preliminary results show that TiO_2 nanoparticles can successfully be incorporated in the film. In addition, as in low-pressure plasma conditions, electrostatic forces were found to play a very important role on the transport of nanoparticles in the discharge. As a result, an appropriate tuning of the applied voltage waveform (shape, amplitude and frequency) was found to directly impact the spatial distribution of nanoparticles in the film.

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UV Photo-Chlorination and -Bromination of Single-walled Carbon Nanotubes

Carbon nanotubes (CNTs) have many desirable bulk properties, however, their surfaces often require modification in order to achieve functionality. To help control the electronic behavior of CNTs, electron-withdrawing halogen atoms are often covalently bonded to the surface to assist in the conversion from metallic to semiconducting structure.

Single-walled carbon nanotubes (SWNTs) were surface modified using UV photo-dissociation of gaseous Cl_2, HCl and HBr, and analyzed by X-ray photoelectron spectroscopy. Chlorine atoms reacted more readily than bromine atoms with the p-conjugation of the SWNTs to form covalent halogenated functional groups. Chlorine atoms, generated by UV photolysis of Cl_2, produced a higher Cl saturation level than previously observed for multi-walled carbon nanotubes (*ca.* 13 atomic % Cl) [1].The degree of chlorination depended on the amount of oxygen on the surface of the SWNTs. Photo-dissociation of gaseous HCl and HBr showed lower amounts of halogenation than Cl_2 photolysis.

[1] L. Oliveira, T. Debies and G. A. Takacs, *J. Adhesion Sci. Technol.* 26, 221-230 (2012).

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B. Riedl, V. Vardanyan, A. Kaboorani, B. Poaty and G. Chauve; Département des sciences du bois et de la forêt, faculté de géomatique, géographie et foresterie, Centre de recherche sur le bois, Université Laval, Québec Canada G1K 7P4

Modified Nanocellulose for Composite Coatings

There is a continuous need to develop new, more performant coatings. Opaque coatings usually contain microparticles, but as opacifyng agents. In this work, nanocellulose (NCC), extracted from Canadian wood, was evaluated as an additive, mainly as a strengthening agent. Indeed, there are few instances of paints /coatings in the literature, reinforced with nanofibers. Coatings investigated were water-based acrylates of UV-cured type, both transparent and opaque. Mixtures were formulated and NCC as powder was added. The NCC was used as supplied by the manufacturer, or modified with an hydrophobic quaternary amine-based soap, HMTA. Coatings were applied to substrate and cured under UV light. Quality of NCC dispersion was evaluated with Atomic Force Microscope (AFM), as well as salient mechanical and optical properties. Results show that some although there is clear evidence, with AFM, that NCC is somewhat not very well dispersed in coating, addition of 2% HMTA treated NCC to coating increased resistance to wear, a key property, up to 40%. Optical properties, as color and brillance were retained. Results will also be shown for contact angle data on these modified nanoparticles.

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Surface Characterization of Modified Nanocrystalline Cellulose (NCC)

Surface modification of nanocrystalline cellulose (NCC) is very important to broaden the applications of NCC. In this research, surface of NCC was modified by using a cationic surfactant. The concentration of the surfactant and duration of the reaction were considered variable in order to produce NCC with different degree of hydrophobicity. Various surface characterization methods were used to examine the effectiveness of the modification, including fourier transforms infrared spectroscopy (FTIR), X-ray photoelectron spectroscopy (XPS), atomic force microscopy (AFM) and scanning electron microscope (SEM). The results of this study showed that the cationic surfactant is effective in changing the surface nature of NCC. XPS determined the chemical compositions of unmodified and modified NCC much more precisely than FT-IR. AFM determined the surface nature and dimensions of NCC after and before modification. Although SEM could reveal the effects of the modification, it fell short in determining the degree of modification.

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Raymond A Pearson and Sepideh Khoee; Materials Research Center,
Lehigh Unversity, Bethlehem, PA

Epoxy Modified with Block Copolymers: the Role of Bondline Thickness on Adhesive Strength

The addition of a block copolymer to an epoxy resin can result in a rubber-modified epoxy with nanometer-size particles. In this work, we compare a ductile epoxy modified with a styrene-butadiene-methylmethacrylate block copolymer (SBM) with the same epoxy modified with a carboxyl-terminated butadiene acrylonitrile copolymer (CTBN). The CTBN-modified epoxy results in a blend containing 3 micron diameter rubber particles and the SBM-modified epoxies results in a blend containing 50 nanometer diameter rubber particles. Although the bulk fracture toughness of the two blends are similar the interfacial fracture toughness is significantly higher for the nanostructrured blend. Fracture mechanisms and models will be discussed to explain these differences.

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2) Berlin Institute of Technology (TU Berlin), Institute of Materials Science and Technology, Polymer Engineering/Polymer Physics, D-10623 Berlin, GERMANY

Bio-Fiber Reinforced Polymer Composite: Role of Compatibilizer

Recent advances in engineering, natural fiber development and composite science offer significant opportunities for new, improved materials and for renewable resources which can be biodegradable and recyclable but also obtained from sustainable source at the same time. The combination of bio-fiber like betel nut, banana, coir, jute, rice straw, tea dust and various grasses with polymer matrices from both non-renewable and renewable resources to produce composite materials that are competitive with synthetic composites. This presentation will provide a general overview of bio-polymers, natural fibers, bio-composites as well as the research and application of these materials. Role of additives and compatibilizers on the natural fiber polymer composites is also included herein with respect to of current research advancement. A discussion about chemical nature, processing, testing and the properties of bio-based polymer composites will be attempted.

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Ahmed Abou-Kandil [1, 2], Nabila Darwish[2] , Adel Shehata[2], Samir Lawandy[2],
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1) National Institute of Standards, Tersa Street, El-Haram, El-Giza, P.O. Box 136, Giza 12211, EGYPT

2) Egypt Nanotechnology Center, Smart Village, Building 121, Cairo-Alexandria Deseret Road, 12577, EGYPT

Promoting Adhesion of Natural Rubber to Brass Plated Steel Cords

Adhesion of natural rubber to brass plated steel cords is of extreme importance to the rubber industry in general, and the tire industry in particular. Here, we present a novel promoter, Kaolin Modified Rubber (KMR) and study its use in promoting adhesion of such a system compared to a widely used commercial promoter in the industry (manobond). Our results reveal the superiority of the new adhesion promoter and its durability during severe static and dynamic conditions. We modified a standard de Mattie Flexing machine for this purpose and used standard T-Pull out test samples for studying the adhesion under dynamic conditions. Analysis of Variance (ANOVA) was also used to confirm the static and dynamic mechanical results.

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Dounya Baritt[1], Houda Ennaceri[1], Ahmed Ennaoui[2], Adil Chaboun[3] and Asmae Khaldoun[1]

1) Al Akhawayn University School of Science and Engineering, MOROCCO

2) HZB, Helmholtz-Zentrum Berlin für Materialien und Energie, GERMANY

3) Abdel Malek Essaadi University, Faculté des Sciences et Techniques de Tanger, MOROCCO

Nanocoating and Testing; a Step Towards the Improvement of CSP Reflectors for less Intensive Maintenance Both in Terms of Labor and Water

The conversion of sunlight energy to heat or electrical energy using Concentrated Solar Power is based on a very simple technical process. Mirrors are used to focus sunlight to a receiver where it can be collected as heat, which is then carried away by a heat transfer fluid flowing through the collector. The heat transfer fluid links the solar collectors to the power generation system, carrying thermal energy from each collector to a central steam generator or thermal storage system as it circulates. The efficiency of the CSP plante is dramatically affected by the deposition of water, dust on the surface of the reflector's mirror. The aim of this work is to reduce the need of maintenance while improving the mirrors efficiency. The first step in this study is the physico chemical characterization of the surface of usual mirrors used in the CSP plants in Morocco. A laboratory research of the surface free energy of the reflectors and the surface free energy of interaction of the reflectors with water, salt and dust extracted from different potential CSP plant installations area in morocco. This study will allow us to conclude about the ability of these surfaces to attract or repel dust and moisture. The Surface free energy is determined from measurements of advancing contact angles of three probe liquids of known surface tension components on the different mirrors and soils platelets using a Goniometer.

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