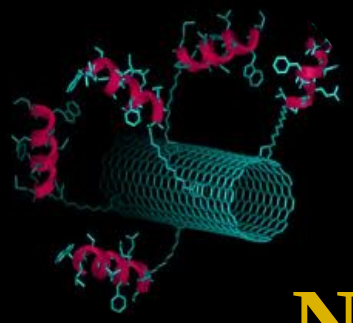
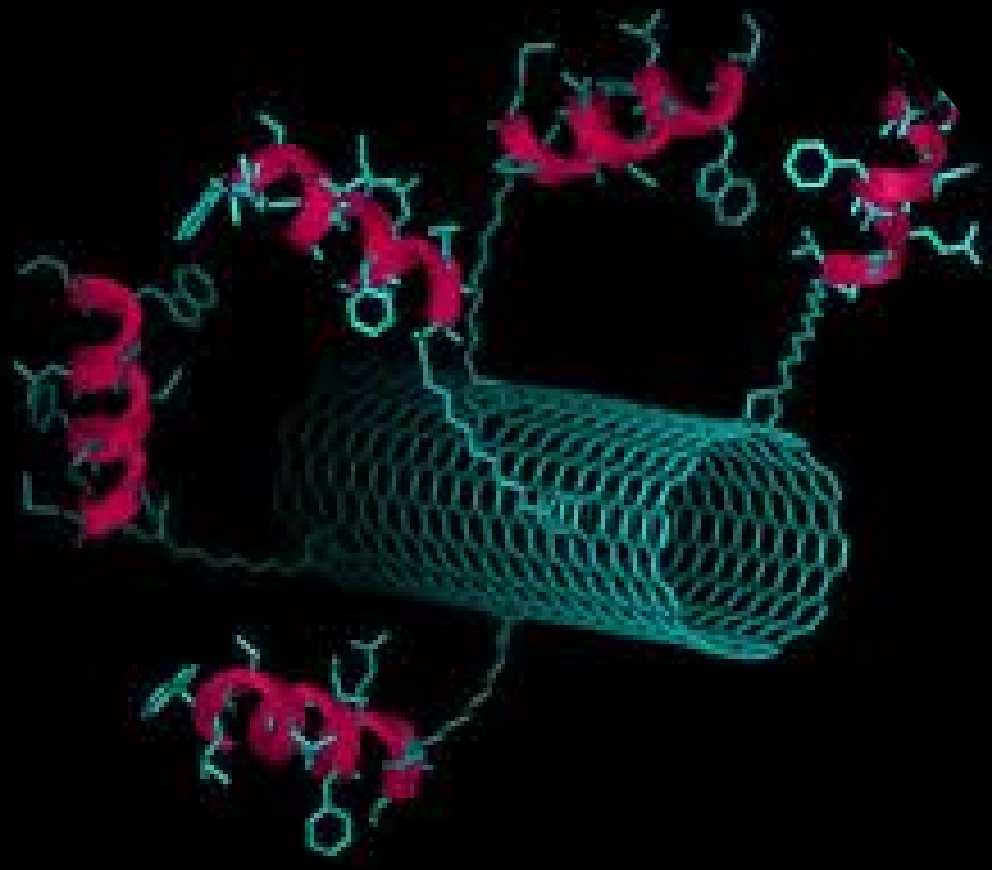


Abstracts

NanoBio Summit 2013



Invited Speakers Abstracts

Shape-controlled Iron Oxide Nanoparticles as Efficient MRI contrast Agents

Yuping Bao
Chemical and Biological Engineering,
The University of Alabama, Tuscaloosa, AL

Magnetic resonance imaging (MRI) offers a powerful, non-invasive tool for brain tumor imaging and therapy monitoring. The use of contrast agents significantly enhances the image contrasts, yielding better resolution. T1 positive contrast agents are mainly paramagnetic Gadolinium (Gd) complexes, which shorten the longitudinal relaxation time (T1) and generate a brighter image. T2 negative contrast agents, primarily superparamagnetic iron oxide nanoparticles, produce a darker image by shortening the transverse relaxation time (T2). Compared to the well-studied Gd-based contrast agents, the correlation between the nanoparticle parameters and corresponding relaxivities are not well understood. In this presentation, we will discuss the role of nanoparticle shapes in their effectiveness as MRI contrast agents. Specifically, we will present the synthetic methods to generate magnetic iron oxide nanowires, plates, cubes, and then discuss their performance as MRI contrast agents by comparing with iron oxide nanospheres.

PCL/ Maltodextrin Nano-Particle as Carrier for Targeted Delivery of Tumor Suppressor Id4 in Prostate Cancer

Jaideep Chaudhary
Clark Atlanta University, Atlanta, GA

Id4, a helix loop helix transcriptional regulator is epigenetically silenced in many cancers including prostate. Id4 is also required for prostate development: In Id4-/- mouse models, prostate development is impaired and leads to PIN like lesions by six weeks of age. In prostate cancer cell lines, expression of Id4 correlates with tumorigenic potential. Id4 expression is observed in the androgen sensitive and less tumorigenic-LNCaP cells whereas Id4 expression is lost in tumorigenic and androgen insensitive C81, DU145 and PC3 cells due to promoter hyper-methylation. Ectopic expression of Id4 in DU145 cells blocks proliferation through CDKNIs p27 and p21, promotes apoptosis and increases sensitivity to doxorubicin. Moreover, silencing of Id4 in LNCaP cells promotes tumor formation in castrated mice suggesting that loss of Id4 leads to castration resistant prostate cancer (CRPC). These results suggested that Id4 acts as a potent tumor suppressor and its loss promotes CRPC. Based on these results we hypothesized that targeted delivery of recombinant Id4 to prostate cancer cells could be used as an effective anti-prostate cancer therapy. Recombinant Id4 was successfully loaded onto PCL/Maltodextrin nano-particles. Positive Id4 immuno-reactivity in LNCaP cells silenced with Id4 sh-RNA (LNCaP-Id4) and DU145 demonstrated successful uptake of Id4 loaded PCL/ Maltodextrin nano-particle. The non-particle delivery of Id4 resulted in decreased proliferation, G1 arrest, increased apoptosis and decreased tumorigenecity as determined in a in soft agar assay. These results suggested that nano-particle based delivery of recombinant Id4 could be used as an alternate therapy for prostate cancer.

Higher Order Architectures and Bio Functionalization of Graphene Shells Encapsulated Nanoparticles for Sensors

Nitin Chopra
Metallurgical and Materials Engineering,
The University of Alabama, Tuscaloosa, AL

Combining graphitic carbon with noble metal nanoparticles is an interesting heterostructure leading to unique multifunctionality in the form of superior thermal, optical, and chemical characteristics.The major focus of our research is on developing multi-component architectures comprised of graphene shells encapsulated gold nanoparticles. The growth of these hybrid nanoparticles is achieved in a unique chemical vapor deposition process, which allows for control over the thickness of graphene shells. The hybrid nanoparticles are thoroughly characterized for their structure, lattice, chemical compositions, and interfaces. Furthermore, the graphene shells were chemically derivatized with different functional groups and studied for plasmonics and fluorescence sensing for biomolecules. This approach was further extended to organize assemblies of other nanostructures on these hybrid nanoparticles. The studies indicate that heterostructured architectures can allow for precise tuning of properties and hold strong potential for sensing and nanoarchitecture applications.

Bulk Multifunctional Materials from Nanocylinders and Nature

Virginia A. Davis
Department of Chemical Engineering,
Auburn University

Natural and synthetic nanocylinders such as carbon nanotubes, inorganic nanowires, and cellulose nanocrystals all have intriguing intrinsic properties and a broad range of potential applications. Combining these nanocylinders with DNA and/or enzymes results

in multifunctional materials that can be produced through scalable fluid phase processing methods. For example, organophosphate sensors have been developed by assembling layers of carbon nanotubes with DNA and organophosphate hydrolase. Carbon nanotubes in combination with lysozyme, a natural antimicrobial, have been used to create coatings, films, and fibers which are mechanically robust, electrically conductive, and antimicrobial. Carbon nanotubes and enzymes have also been used in biofuel cells that mimic the natural Krebs` cycle. Silver, well known for its antimicrobial properties, can be used alone or in combination with enzymes to achieve multifunctional systems such as conductive transparent displays with inherent antimicrobial properties. Successful optimization of all of these systems requires understanding the thermodynamic and mechanical forces governing the assembly of nanomaterials and enzymes from fluid dispersions. This talk will highlight recent successes in both advancing fundamental understanding and achieving useful multifunctional materials.

Fabrication and Characterization of a Biomimetic Polymeric Ligament Scaffold

Derrick Dean
University of Alabama at Birmingham

The human anterior cruciate ligament (ACL) is ruptured over 200,000 times per year (or an incidence of 1 in 3000) in the United States,resulting in over $1 billion of medical expenses. Orthopedic reconstruction is typically done using autograph or allograph tissue, both with significant disadvantages. In this study, we have attempted to replicate the composition, morphology and mechanical properties of the ACL using a nanomatrix composite of highly-aligned poly (lactic acid) (PLA) fibers with various surface and biochemical modifications A bioinkjet printer was used to pattern nanoparticulate hydroxyapatite (HANP) on the surface of the scaffold. The HANP bioink was printed over a gradient pattern mimetic of (and spatially corresponding to) the mineralization gradient found over the microanatomy at the ACL enthesis. Proliferation and differentiation response of human mesenchymal stem cells (hMSCs) in vitro was assessed for a variety of conditions and combinations of the PLA nanofiber scaffold surface modifications (inclusive and exclusive of HANP, fibrin, and various time dependent NaOH treatments). It was found that a combinatory effect of the HANP gradient with fibrin on NaOH treated PLA nanofibers enhanced the osteogenic differentiation of hMSCs, with an observable morphological change spatially corresponding to the compositional changes of the printed HANP gradient. Using the bioactive scaffold designed in this study as a template and expanding on the methods utilized, future studies can incorporate specific growth factors and other organic/inorganic biomolecules to further develop the engineered PLA nanomatrix into a functional ligament-replacement graft.

NIR Photothermal Nano-conjugates for Combined Targeting, Imaging, and Treating Tumors

Hadiyah-Nicole Green
Tuskegee University, Tuskegee, AL

As a potential localized cancer therapy, nanoparticle enabled near infrared (NIR) photothermal therapy has realized limited success in *in vivo* studies. This is primarily due to a lack of successful methods to overcome nanoparticle uptake by the reticuloendothelial system and deliver sufficient quantities of nanoparticles to the tumor site. In the present work, gold nanorod and fluorescently-labeled tumor-specific antibody conjugates provided a 3-in-1 system combining targeted nanorod delivery, fluorescent imaging, and NIR photothermal therapy of malignant tumors. The innovative conjugation techniques and molar ratio parameters provided a nearly 15-fold improvement in the targeted delivery of the nanorods to overly-expressed epidermal growth factor receptors (EGFR) on malignant tumors. The dye-antibody-nanorod conjugate and NIR irradation killed approximately 90% of tumor cells *in vitro* and provided a 40% reduction in tumor volume *in vivo*. This approach could serve as the prototype for combining early detection with localized and repeatable treatments for a variety of tumors that over-express EGFR including breast, bladder, cervical, colorectal, head and neck, lung, ovarian, pancreatic, and prostate cancers.

Monodisperse Carbon Nanomaterials for Electronics, Energy, and Medicine

Mark C. Hersam
Department of Materials Science and Engineering,
Northwestern University
Evanston, IL

Recent years have seen substantial improvements in the structural, chemical, and electronic monodispersity of carbon nanomaterials, leading to improved performance in a variety of applications. For example, high purity semiconducting single-walled carbon nanotubes (SWCNTs) allow the fabrication of thin-film field-effect transistors with concurrently high transconductance, mobility, and on/off ratio and/or high frequency operation exceeding 150 GHz. Using dielectrophoretic assembly, arrays of individual SWCNT transistors can also be realized with high yield. Similarly, high performance digital circuits can be fabricated from semiconducting SWCNT inks via

aerosol jet printing. Beyond transistors, semiconducting SWCNTs have been utilized for light-emitting optoelectronic devices or chemical/biological sensors, while metallic SWCNTs are well-suited as transparent conductors in organic photovoltaics. This talk will also explore the utility of chemically functionalized graphene for high-frequency transistors, metal-oxide-graphene capacitors, charge blocking layers in organic photovoltaics, biomedical imaging contrast agents, and supports for photocatalytic production of solar fuels.

Functional Nanostructures to Control Material-Cell Interactions

Ishrat M Khan
Clark Atlanta University, Atlanta, GA

Functional nanomaterials have a broad range of potential uses in biomedical applications e.g. drugs, drug-delivery, tissue engineering, diagnostics. Synthetic, functionalized, biocompatible polymers can be effective antagonists and promising drug candidates. We are developing a model system for creating allergy-effective drugs, using RBL mast cells and anti-2,4 dinitrophenyl (DNP) IgE antibodies that sensitize these cells by binding to high affinity IgE receptors (FcεRI). These polymeric ligands are effective inhibitors of degranulation of mast cells stimulated by a potent allergen and thus are a potential model drug system. Furthermore, water insoluble (higher molecular weight polymers based on the DNP-poly(2-methoxystyrene)) can be electrospun into fibers decorated with functional (DNP) groups capable of specifically engaging target anti- DNP IgE and IgE on mast cell surfaces. We have demonstrated that these nanofibers can be developed as single molecule sensors. Additionally, we will discuss fundamental studies on understanding how to disperse nanostructures and understand the dispersion within a polymer matrix to prepare novel nanocomposites.

Sintering-Resistant Pt Nanocatalysts for Hydrogen Generation from Biomass-Derived Molecules

Yu Lei
Department of Chemical and Materials Engineering;
University of Alabama in Huntsville, Huntsville, AL

Replacement of fossil sources for the generation of fuels from biologically derived feedstocks has several challenges that still need addressing. One of them is that the raw biomass can be insoluble with current fuels because of the presence of large amounts of "organic oxygen". A major challenge to achieving deoxygenation of biological feedstocks is the need for large quantities of hydrogen to do so. Among the most viable solutions is the generation of hydrogen from the biofeedstocks. Typically, to obtain H_2 (as opposed to H_2O) from the conversion of such a molecule requires the use of a supported metal catalyst. Atomic layer deposition (ALD) is a technique for preparing thin films on planar substrates that employs self-limiting chemical reactions between gaseous precursors and a solid surface allowing atomic scale control over the film thickness and composition. One of the distinguishing attributes of ALD is the capability to deposit highly uniform and conformal coatings on surfaces with complex topographies and to infiltrate mesoporous materials. This feature is particularly attractive for the synthesis of heterogeneous catalysts requiring highly dispersed catalytic species on high surface area, mesoporous supports. Consequently, ALD is being explored as an alternative method for preparing advanced catalysts. In this work, we focus on a simple molecule, 1-propanol, with the aim of understanding in detail the steps involved in reforming and production of H_2, CO_2, and other light products. Highly stable platinum catalysts synthesized by ALD exhibited excellent selectivity towards formation of hydrogen.

Building a Targeted, Magnetically Triggered Drug Delivery System for Cancer Chemotherapy

Jacqueline A. Nikles
Department of Chemistry, The University of Alabama at Birmingham, Birmingham, AL

Poly(ethylene glycol-*b*-caprolactone) diblock copolymers and a poly(ethylene glycol-*b*-caprolactone-*b*-ethylene glycol) triblock polymer were prepared by conventional methods. In water the polymers assembled into polymer micelles having semi-crystalline polycaprolactone cores and a poly(ethylene glycol) corona. A cyclic RDG peptide was conjugated to the terminus of some of the poly(ethylene glycol) blocks, thereby conferring targeting to certain cancer cell lines. The critical micelle concentration increased with increasing temperature and the rate of increase was greater at temperatures above the melting point of the polycaprolactone core. Doxorubicin (a cancer drug) and dibucaine (a surrogate for a cancer drug) were loaded into the polymer micelles and isothermal drug release experiments showed that the release increased at temperatures above the melting point of the micelle core. This provides the basis for a thermally triggered drug delivery system. The thermal triggering will be provided by radio frequency AC magnetic field heating of magnetite nanoparticles trapped in the micelle core.

Novel Nanomaterials as Antimicrobials

Shreekumar R. Pillai
Center for Nanobiotechnology Research,
Alabama State University, Montgomery, AL

There is an inexorable need to develop novel anti-microbials to combat the development of multi-drug resistant life threatening infectious agents. The Center for Nanobiotechnology Research at Alabama State

University is engaged in the development of unique nanomaterials as antimicrobial agents. Metal nanoparticles and antimicrobial peptides have garnered increasing attention due to their ability to kill a wide range of infectious agents. Here, we will present information on the characterization of metal nanoparticles such as silver and gold, their encapsulation in biocompatible polymers, and strategies for their conjugation with various proprietary peptides. The effectiveness of these nanomaterials against common bacterial and viral pathogens are currently being tested with the goal of developing novel antimicrobial treatment options.

Design Nanomaterials for Biomedical Applications

Vijaya Rangari,
Material Science and Engineering,
Tuskegee University, AL

Nanoparticles are widely used because of their unique tunable properties and application in automobile, electronic, textile, energy, aerospace and biomedical fields. Recently development and applications of nanoparticles derived from natural source such as plant or an animal are gaining attention due to the high cost and environmental hazard of the petroleum and mineral derived products. This presentation covers the range of nanotechnology applications in polymer composite and biomedical fields. These include the synthesis and characterization of various types of bio-nanomaterials obtained from renewable resources such as eggshell and other nanoparticles such as ZnO, TiO_2, Ag, CNTs, and their hybrid nanoparticles were used to improve the mechanical and antimicrobial, UV absorbing properties of textile fibers. Biocompatible magnetic and non magnetic particles ranging from nanometre to micrometer scale are also increasingly being used in a biomedical and drug delivery application. Nanoparticulate-based drug delivery systems are being developed to control the release of drug in the body to protect the drug from enzymatic or chemical degradation, and to attain organ or tissue-targeted delivery. Targeted drug delivery of a cytotoxic drug is beneficial to maximize the efficacy of the drug and reduce side effects associated with its delivery. The important properties of these biobased nanomaterials are non-toxicity, biocompatibility, injectability, and high-level accumulation in the target tissue or organ.

UV/Visible Lithography on Biological and Polymer Substrates

Anup Sharma, Carlton Farley, Aschalew Kassu,
Praveen Ranganath, Sathyanarayan Rao
Alabama A&M Univ., Huntsville, AL

Interferometric Lithography is used to produce micron-scale periodic structures in biomembranes and other substrates of biological interest like polymers. Phospholipids are one of the major constituents of biological cell membranes and lipidic films have found extensive uses as simple models of cell membranes. Model biomembranes are known to be excellent platforms for biosensing. UV interferometric lithography has also been accomplished in melanin thin films as well as polymers like polybutadiene. UV Photodegradation is measured in these films by this technique. Lithographic masks have also been used to immobilize biomolecules on polymer surfaces using visible light. The technique has a potential for biosensing applications.

Light Microscopy Imaging at the Nanometer Level –Nikon's N-STORM and N-SIM Microscope Systems

Joel S Silfies
Applications, Training & Product Development,
Nikon Instruments Inc.

We will explore the traditional diffraction limit in light microscopy which limited resolution to greater than 250 nm. Then we will examine two "Super-Resolution" microscopy techniques which allow improvement in the resolving power of the Light Microscope. N-STORM Stochastic Optical Reconstruction Microscopy which allows for resolution in the range of ~25 nm in XY and ~50 nm in Z. We will also explore N-SIM Structured Illumination Microscopy which provides the ability to resolve down to ~100 nm in XY and ~350 nm in Z. Finally, we will review examples of how these techniques are being utilized to explore previously unanswerable biological research questions. During this talk we will examine two different light microscopy techniques which have been developed to allow imaging beyond the traditional 250nm resolution limit of the light microscope. We will start by trying to understand the underlying reasons this physical barrier exists and then learn how several novel methods have been developed to circumvent this limit. N-SIM structured illumination microscopy uses patterned light to allow imaging with resolutions of ~100nm XY and ~350 nm in Z. N-STORM or Stochastic Optical Reconstruction Microscopy provides for reduction of the resolution limit to ~25 nm XY and ~50nm in Z. We will see how these techniques are implemented on the light microscope, sample requirements and other considerations for use of these techniques. Finally we will examine some specific applications which have taken advantage of these new imaging methods.

Protective Effects of Silver Nanoparticles Against Ultraviolet Radiation-Induced Apoptosis and DNA Damage in Human Keratinocytes: Potential Implications in Prevention of Skin Carcinogenesis

Seema Singh
Mitchell Cancer Institute, University of South Alabama, Mobile, AL

Exposure to ultraviolet (UV) radiation from sun remains the foremost epidemiological cause of skin malignancies, which account for more than a million new cases each year in the United States alone. Direct exposure of skin to UV radiation causes DNA damage, which if not corrected, leads to accumulation of carcinogenic mutations over time and results in transformation of cutaneous cells. . Hence, there is a pressing need for the development of a novel, safe and effective preventive approach to combat UV radiation-induced deleterious effects. In this study, we have studied the chemoprotective role of silver nanoparticles (Ag NPs) against UV radiation-induced skin damage. Our data demonstrate pretreatment of human immortalized keratinocytes (HaCaT) with AgNPs: ***i)*** leads to reduced formation of cyclobutane pyrimidine dimers (CPDs) upon exposure to UVB radiation, ***ii)*** protects the HaCaT keratinocytes from UVB radiation-induced apoptosis, ***iii)*** suppresses basal as well as UVB-induced ROS production, and ***iv)*** induces cell cycle arrest in G1/S phase These findings provide strong support for chemoprotective efficacy of AgNPs and warrant future investigations on the mechanism and function in suitable animal model system.

Nanoparticle-Based Platforms for Therapy of Cancer

Jamboor K. Vishwanatha,
Department of Genetics and Molecular Biology and Institute for Cancer Research,
University of North Texas Health Science Center, Fort Worth, TX

Nanotechnology when engineered together with biotechnology opens a fascinating field with applications in diverse areas such as drug targeting and delivery, medical imaging, biosensing, biomaterials and nanotechnology. Recent advances in nanoscience and nanotechnology have led to the development of combinatorial nanosystems. It is highly desirable that nanoparticles can not only provide sensitive imaging and selectively deliver anticancer drugs to tumor sites but also specific targeting. Targeting anticancer drugs to their specific molecular targets is a major challenge in cancer therapy. In our studies, we used a novel non-covalent insertion of a homo-bifunctional spacer for targeted delivery of curcumin to various cancer cells. Curcumin has been found to be very efficacious against various cancer cells. In our studies, we demonstrated successful conjugation of antibodies, Annexin A2 or PSMA, to curcumin loaded PLGA nanoparticles for targeting to breast and prostate cancer cells respectively. These developments and results have emphasized the potential of our multifunctional nanoparticles to improve the clinical efficacy of nanoparticle based therapy in patients with cancer.

Detection of Mutant RNAs Derived from a Single Bacterial Cell with a cRNA-based Biosensor

Jacek Wower
Animal Sciences and AU Detection and Food Safety Center, Auburn University, Auburn, AL

We developed a biosensor for the rapid detection of bacterial RNAs. In our assay, the target RNA molecule is first converted into a complementary RNA (cRNA) and then amplified using isothermal RNA amplification. The detection of the cRNAs requires two independent hybridization reactions. In the first reaction, the receptor module captures cRNA molecules. The second reaction involves base pairing of cRNA molecules with various types of enhancers. The requirement for two independent hybridization reactions permits manipulation of the biosensor to optimize the specificity and sensitivity of target RNA detection. Our biosensor targets tmRNA, an RNA molecule that is only present in bacteria. Therefore, the possibility that RNAs derived from eukaryotic organisms will interfere with the detection process is minimal. Our studies demonstrated that 10-17 M cRNAs could be detected using DNA-linked gold nanoparticles (DNA-Au-NPs). Given that each actively dividing E. coli cell contains 3,000 tmRNA molecules, and a two-minute-long IRA reaction produces thousands of cRNA copies, the cRNA-based biosensor is able to detect a single cell of E. coli grown in a liquid culture. To increase sensitivity of detection, we use RNA networks composed of multiple copies of an aptamer that binds 3,5-difluoro-4-hydroxybenzylidene midazolinone (DFHBI) as an enhancer. When bound to its RNA aptamer, DFHBI emits strong fluorescence that can be readily onitored by minimally trained personnel. Auburn University has a patent pending application for the cRNA detection technology *We acknowledge the National Science Foundation (Grant 1063536) and the Upchurch Fund for Excellence for funding this project.*

All abstracts are arranged alphabetically by first author's last name.

Undergraduate Student Presentations

UP-01. Studies on Some Plant Extracts and Nanoparticles for Their Anti-Breast Cancer Activities

Charles Ahweyevu, Louise Wrensford, Murtada A. Taha
Department of Natural Sciences, Albany State University

Cancer refers to a broad group of diseases that involve unregulated cell growth, invasion, and metastasis that form malignant tumors, which ultimately lead to death. Breast cancer is the most common type of cancer in women living in Western nations. It is estimated that approximately 1 in 8 North American females will develop breast cancer throughout their lifetime. The best way to battle cancer or any disease is prevention. One of the most researched aspects of chemoprevention is the use of natural products due to its cost effectiveness and little toxic side effects as opposed to other synthetic methods of chemo-treatment. Both biochemical and microscopic techniques were used to investigate the anti-breast cancer activities of seven different preparations namely; Milk thistle extract (MTE), Ginkgo biloba extract (GBE), selenium (Se), Se-MTE, Se-GBE, chitosan, and Se-chitosan nanoparticles. These natural products have previously shown to have various forms of anti-cancer activities. Our results showed that selenium and chitosan at 5ng/ml and 250 µg/ml respectively, inhibit the growth of the 4T1 cancer cells *in vitro* while none of the other preparations have any inhibitory effects, and hence, further studies are required to confirm this result.

UP-02. PEG-functionalized CNT: Design and Application as Loading Surface for Anti-Cancer Drug Docetaxel

Brandi Barlow, Akanksha Sood, Pooja M. Tiwari, Swapnil Bawage, Shree R. Singh, Komal Vig
Center for NanoBiotechnology Research, Alabama State University

Carbon nanotubes are one of the most commonly studied nanomaterials and are the preferred materials for various biochemical and medicinal applications. Due to their large surface area and impressive physical and chemical properties single-walled carbon nanotubes (SWNT) have been tremendously exploited for conjugation with variety of molecules such as drugs, proteins, peptide etc. for therapeutic as well as diagnostic purposes. In the present study, SWNT were used as matrix for loading the anti-cancer drug Docetaxel (DOX). SWNTs were first functionalized with PL-PEG amine to increase water solubility and bio-compatibility. These functionalized SWNTs were then conjugated with the drug docetaxel under basic conditions. Since cancer cells have an acidic microenvironment, the change in pH triggers the release of drug in cancer cells. The functionalization of the SWNT with PL-PEG and the loading of the drug were confirmed using FT-IR technique. Peaks corresponding to amine group, alkyl group and carbonyl group stretch in the SWNT-PEG graph confirmed the PEGylation. Also, the peak corresponding to alkyl group stretch in the SWNT-DOX graph which was absent in the Docetaxel graph confirmed the loading of the drug. It was concluded from the MTT assay that both the SWNT-PEG (PEGylated SWNT) and the SWNT-PEG-DOX (PEGylated SWNT with the DOX attached) were more cytotoxic to HeLa cells as compared to the HEp-2 cells. The SWNT-DOX system can be targeted more specifically by conjugating with peptides that bind to the cancer cell receptors. Hence, SWNT are novel materials that can be fruitfully employed in increasing the efficacy of the presently used cancer treatments.

UP-03. Cloning and Sequencing of a Plant GAPDH gene

Brandi Bethune, Langston Grant and Abigail S. Newsome
Center for Nanobiotechnolgy Research, Alabama State University

Glyceraldehyde-3-phosphate dehydrogenase (GAPDH) is a critical enzyme that codes for a protein that is catalyzed in the sixth step of glycolysis, the process of converting glucose into pyruvate to produce energy. In the experiment, Polymerase Chain Reaction (PCR) was used to prepare the gene GAPDH for sequencing so that the gene could be compared to genes of the same type. DNA extracting was used to isolate the genomic DNA of interest. Once the DNA was fully extracted, PCR was used to amplify a portion of the DNA molecule. Agarose Gel Electrophoresis was used to separate the DNA portions by size and also to determine the number of PCR products, the presence of the band, and the strength of the band. Electrophoresis showed plant DNA was amplified in the nested products. Once the desired segment was amplified, fragments were inserted into pJet1.2 plasmids to be propagated. In the process of transformation after incubation overnight, there were no colonies.

UP-04. Synthesis of Azide Ligands for PAMAM Dendrimers

Michael County Jr.
Dept of Chemistry, Southern University at Shreveport

In 2007, cancer caused about 13% of all human deaths worldwide (7.9 million). Rates are rising as more people live to an old age and as mass lifestyle changes occur in the developing world. Current treatments of cancer include invasive and destructive techniques such as radiation and surgery, with hidden and toxic side effects. One way of combating the side effects of surgery and chemotherapy is by using targeted drug delivery made from Poly (amido amine) (PAMAM) dendrimers. Our task was to synthesis azide Ligands for the conjugation of PAMAM dendrimers. Dendrimers are starbranch polymers that can be synthesized by generation, increasing in size and number of terminal amines. Small functional molecules, such as cell targeting agents, drugs, and dyes, can attach to the terminal amines creating a multifunctional macromolecule. Unfortunately, these conjugation reactions result in a distribution of products varying in numbers of conjugates which are difficult to separate from each other. The azide ligand is very polar and allows prep-HPLC separation of the populations. It will also give a unique point of attachment for the small functional molecules to control the number of conjugates per polymer.We believe by controlling the stoichiometry of conjugates that this will aid nano-delivery systems transition by eliminating polydispersity.

UP-05. Production Effects on Vapor Grown Carbon Fiber (VGCF) and Multi-Walled Nanotube (MWNT) Bucky-Papers

Amber Hubbard, Patricia Murdock, Virginia A. Davis
Dept. of Chemical Engineering, Auburn University

Bucky-papers are essentially thin wafer-like papers made from carbon nanomaterials that have been dispersed and filtered. They have vast potential in many areas including fuel cells, aerospace structures, and even as a supplement to steel. Much research has gone into understanding and improving this practical form of carbon nanomaterials. In this work, carbon nanomaterials were dispersed in isopropanol, with the aid of both stirring and sonication, and then filtered using a vacuum pump. Bucky-papers were produced in the form of both 100% VGCF and 66 % VGCF/33%MWNT mixtures. The effects of vacuum filtration pressure, stirring, and sonication times on the bucky-paper pore size distribution were measured using capillary flow porometry. This yielded an understanding of the inter-relationships between dispersion state, filtration pressure, and permeability.

UP-06. Green synthesis of Robust, Biocompatible Silver Nanoparticles Stabilized by Polyethylene Glycol

[1]Sapna Jain, [1]**Jasmyn Rainey**, [2]S. Pillai, [2] S. Singh
[1]Dept. of Physical Science, Alabama State University
[2]Center for NanoBiotechnology, Alabama State University

Silver nanoparticles show remarkable properties, when layered onto a substrate and incorporated into organic or inorganic matrices. Their enhanced properties are shape and size dependent. Ethylene glycol and its polymers are environment friendly or environmentally benign materials as compared to the other reducing agents like hydrazine, dimethyl formamide, sodium borohydride etc. used in the preparation of nanoparticles. In this paper the role of poly ethylene glycol (PEG) as a reducing as well as stabilizing agent has been studied. The reducing reactivity of PEG is sensitive to its molecular weight, thus a study has been made on establishing the optimum length of PEG that exhibits maximum reducing abilities. Different molecular weight PEG, ranging from 200 to 8000 were tried. Low molecular weight PEG stabilizes some nanoparticles but some of them rapidly agglomerate and silver with large dimensions are formed. UV-visible spectroscopy, FT-IR spectroscopy, transmission electron microscopic studies (TEM) and scanning electron microscopic (SEM) studies were used to characterize the nanoparticles. The antibacterial activity of the silver-PEG will be compared against that of commercially available silver nanoparticles.

UP-07. RNA-Coliphage Q-Beta Displayed Nano-Tags as a Platform for Nanoparticles: A Novel Drugs Cargo

Kelvin Jones, Shanavia Crenshaw, Rana Singleton, Alain B. Waffo
Dept of Biological Science, Alabama State University

There are a growing number of potential therapeutic molecules (biodrugs) presenting some serious challenges: *in vivo* degradation,indiscriminate distribution and severe toxicity. This shortcoming may be overcome by targeted drug-carrying platforms that protect and ferry the drugs to the target tissues with nanoparticles. We hypothesize that by attaching nanoparticles to the surface of the bacteriophage Qβ which displays a well know number of nano-tags, the chimera phage platform produced will act as a modular carrier system for biodrug scaffolding and delivery. To achieve this goal, nano-tag genes histidine-tag, streptavidin-tag and avidin-tag were inserted into the cDNA of Qβ A1 gene separately and displayed on the exterior surface of the phage Qβ. These hybrid phages with nano-tags were designated as pQβ(His)8, pQβStrep and pQβAvid. The hybrid phage titers were lower than the wild type (108 – 109 pfu). The correct tag gene size was confirmed by RT-PCR from plaques of each phage type. Ouchterlony double diffusion was performed with phages and the corresponding antibodies, which confirmed the presence of the tags on the phage surface. The Qβ(His)8 phages were analyzed through scanning electron microscopy (SEM) with anti-His-tag antibodies and has confirmed the success of the Qβ phage displaying histidine tag. We are currently analyzing other hybrid phages constructed. To our knowledge this is the first report on RNA coliphage Qβ displaying biologically useful surface tags or peptides. Future work will involve attachment of functionalized, biotinylated or conjugated streptavidin nanoparticles to these hybrid phages to assess biodrug scaffolding and delivery in animal model.

UP-08. Chemical Analysis of Forensic Evidence Methamphetamine and Body Fluids

Rebekah Jones and Harvey J.M. Hou
Dept. of Physical Sciences, Alabama State University

Forensic evidences and their impurities, forensic evidence impurity signature, contain vital information for tracing their origins and their transfer pathways and can be used to provide link in crime scene investigation and law enforcement. The effect of diverse environmental conditions, including light, temperature, pH, and bacteria, on the controlled substances is one essential way for the production and generation of their impurities. In this work we investigated the responses of methamphetamine to the UV irradiation by the ultraviolet-visible-near-infrared (UV-Vis-NIR) spectroscopy and the gas chromatography-mass spectrometry (GC-MS). Methamphetamine has a high potential for abuse and is among the top list in illicit drug cases in the United States. We observed that methamphetamine caused the decrease then increase of an absorption peak at 960 nm in aqueous solutions upon UV treatment for 50 min. The observations may be explained as two possibilities. (a) Chemical structural changes of methamphetamine occur under UV irradiation and (b) a novel unknown compound from the drugs is produced. The GC-MS data revealed that one new GC component at the retention time of 12.49 min was observed after exposure to UV light and tentatively assigned to the degradation products of methamphetamine. The additional peak at m/z 73 may be explained by the methylation at N atom in methamphetamine. In addition, the substantial changes involving the appearance and disappearance of multiple GC components in the range of 3-11 min were found and may serve as the UV-induced GCMS fingerprint of methamphetamine. The experimental results may provide insightful information and new strategy for tracing the origin of manufacture and pathway of distribution of methamphetamine. We also performed the analysis and characterization of the body fluids including human urine, human saliva, human sweat, and chicken blood using the Fourier transform infrared spectroscopy (FTIR). The FTIR data showed apparent differences among the body fluids, suggesting that FTIR may be a promising and fast technique for the identification of the body fluids in crime scene investigation.

This work was supported by the NSF HBCU-UP program.

UP-09. Selection for a Loss-of-Function Mutation in the Lycopene Beta-Cyclase (*CpCYC-b*) Gene in Red-Fruited Papaya

Jamicia Lewis, Meng Wu, and Richard C. Moore
Dept. of Biology, Alabama State University

Papaya fruit flesh color is determined by the presence of the caratenoids β-carotene (yellow fruit) or lycopene (red fruit). Red fruit flesh color is caused by an interruption in the carotenoid biosynthesis pathway and specifically by a 2-bp loss-of-function mutation in the chromoplast specific lycopene beta-cyclase (*CpCYC-b).* For this project, we hypothesize that the lack of function mutation is specific to domesticated cultivars and that this allele was subsequently artificially selected in cultivars with red fruit flesh color. If this is true, we expect to see evidence of selection at the CpCYC-b gene in red cultivars, including reduced nucleotide diversity at this gene in red cultivars relative to yellow cultivars and alleles sampled from natural populations. In order to test our predictions, we sequenced the CpCYC-b gene from domesticated cultivars and from broadly dispersed natural populations in Costa Rica. We found that the 2-bp loss of function mutation was present in all red cultivars. It was also found at very low frequencies in natural populations (<10%) and in yellow cultivars in heterozygous individuals. A notable exception was the presence of the allele in natural populations of individuals identified previously as feral escapees. Nucleotide diversity was significantly reduced at this gene in the red cultivars relative to yellow-fruited cultivars and natural populations, suggesting artificial selection for the loss-of function mutation occurred in the domestication history of the red-fruited cultivars.

UP-10. Novel Use of Cellulose Nanocrystals with Melt Extruded Thermoplastic

Rebecca Lin, Virginia Davis
Dept. of Chemical Engineering, Auburn University

Cellulose nanocrystals (CNC) have successfully been used to improve polymer thermal stability, mechanical strength, and other properties. However, the majority of research with CNC has been focused on water soluble polymers. There has been limited investigation of thermoplastics, such as polypropylene, polyethylene, or ethylene vinyl alcohol, which are widely used in commodity and specialty industries. In this work, CNC was co-extruded with ethylene vinyl alcohol (EVOH) with the aim of increasing its glass transition and thermal decomposition temperatures. Changes in these properties provide information on nanomaterial dispersion and nanomaterial-polymer interactions; these properties also affect the range of potential nanocomposite applications. The methodologies and results of this work provide a framework for additional understanding the effects of CNC on EVOH and other thermoplastic polymers.

UP-11. Using Visual Studio 2010 for Windows Phone to Develop Silverlight Applications

Carlton McClain and Iraj Danesh
Alabama State University

Traditionally, among several programming paradigms, students mostly use imperative or object oriented paradigms. Standard Library Functions and Standard Template Library (STL) have been used to strengthen their programming ability. Using current internet era application development can move students` programming abilities to another level, enabling them to code windows phone programs that interfere with physical environment and create sophisticated applications. In this research, entire Windows Phone development environment necessary for developing and testing windows phone applications is studied and used. This includes software development tools such as web-browser Microsoft Silverlight, Microsoft Integrated Development Environment (Visual Studio 2010 Express), .NET Framework 4.0, XNA Framework and XNA Game Studio 4.0, and The Windows Phone Emulator. The frequently used hardware tools used in developing applications for detecting physical phenomena such as motion, speed, and rotation that effects the developer the most are also studied and used. Several windows phone applications are being coded, compiled, and tested by emulator. To observe the differences between Silverlight programming for the web and Silverlight programming for windows phone, these applications will also be ran on actual physical windows phone devices such as Nokia Lumia 900 Windows Phone 7.5. This approach can serve as an addition to pedagogy. It brings about a choice and an auxiliary alternative to advanced programming, specifically in educational settings.

UP-12. The Triangle Intersection Problem for Hexagon Triple Systems

Zachary Meadows and C. Pettis
College of Mathematics and Sciences, Alabama State University

A Steiner triple system of order n is a pair (S,T), where T is a collection of edge disjoint triangles which partitions the edge set K_n (= the complete undirected graph on n vertices) with vertex set S. |T| = n(n-1)/6. The range of triple systems is the set of all n ≡ 1 or 3 (mod 6). A complete solution of the intersection problem for triple systems follows: I(n) = {0,1,2,…,n(n-1)/6}\{x-1,x-2,x-3,x-5} and Int(n) represents the set of all k such that there exists a pair of triple systems of order n having exactly k triples in common. It has also been shown that Int(n)=I(n) for all n≡1 or 3(mod 6), except for n=9. The Triangle Intersection Problem for Hexagon Triple Systems (HTS) states for each n≡ 1 or 3(mod 6)≥7 and each kϵ3I(n)={0,1,2,3, …, n(n-1)/2 = x}\{x-1,x-2,x-3,x-5} construct a pair of 3-fold triple systems of order n intersecting in k triples each of which can be organized into a hexagon triple system. A complete solution for this problem was given with a few possible exceptions for n = 13. A number of the HTS(7) were found not to be perfect. A perfect HTS(n) is one where the inner triples form a STS(n). Once identified, we used the perfect HTS(7) to find solutions to the triangle intersection problem for hexagon triple systems when n=7. We hypothesize that we can strengthen the result of the solution by using perfect HTS(7) to solve the intersection problem for n = 7.

UP-13. Chlamydia Major Outer Membrane Protein (MOMP) Induces High IFN-ϒ and T-cell Proliferative Responses in Mice

Aterica Pearson, Saurabh Dixit, Shree R Singh, Vida Dennis
Southern University Shreveport

Chlamydia trachomatis genital infection possesses problems worldwide. More than 4 million cases were reported to the CDC in 2011. Scientists have worked diligently to develop an efficacious vaccination. The murine model of *C. trachomatis* genital infection has been extremely useful for identification of

protective immune responses and in vaccine development. Although a number of immunogenic antigens have been measured for their ability to induce protection, the majority of studies have used the whole organism and its major outer membrane protein (MOMP) as vaccine candidates. MOMP is the most immune-stimulatory protein identified to date, but it does not induce sterile protection and at the same time it is reported to be immunosuppressive in nature. To begin to identify the immune-stimulatory regions with T-cell epitopes, we immunized three groups of mice at two-week interval as follows: (i) Group1 (PBS + incomplete Freunds adjuvant (ii) Group 2 (live *C. trachomatis*) (iii) Group 3 (rMOMP + incomplete Freunds adjuvant). Mice were sacrificed two weeks after the last immunization, and purified T-cells isolated from spleens of immunized mice were restimulated *in vitro* with Concanavalin A, UV-inactivated *C. trachomatis* and rMOMP. T-cell samples from mice were analyzed by cytokine ELISA for IFN-ϒ production and the MTT assay for T-cell proliferation. Our results revealed that rMOMP "stimulated" T-cells induced maximum production of IFN-ϒ and proliferation as compared to the PBS and *C. trachomatis* immunized groups. We are currently investigating pathways to identify specific immune stimulating regions of MOMP.

UP-14. Analysis of Silver Nanoparticles using Laser-Induced Breakdown Spectroscopy

Kemet B. Preer, Cleon M. Barnett, [1]Komal Vig
Dept. of Mathematics and Computer Science, Dept. of Physical Science, [1]Department of Biological Science, Alabama State University

The effect of excitation wavelength on the sensitivity of the Laser Induced Breakdown Spectroscopy (LIBS) on the analysis of silver nanoparticles is presented. A comparison of the analytical performance from 266 nm and 532 nm laser produced plasmas is presented. For this study suspension of silver nanoparticles ranging in concentration from .01 to 1.0 µg/µL were deposited onto pure aluminum substrates and analyzed using LIBS. In this study we compare the signal to noise ratios and well as the linearity of the calibration curves produced from silver atomic emission lines. In addition, the temporal evolution of the plasma characteristics, such as excitation temperature and plasma density, for both the 266 nm and 532 nm laser produced plasmas is discussed.

UP-15. Effect of Epithelial Cell Lines on the Toxicity of Electrospun Poly (ε-caprolactone) Nanofiber Scaffold

[1]**Christian Rogers**, [1]Elijah Nyairo, [2]Derrick Dean, [2]Vinoy Thomas, [3]James Stokes, [3]Manoj Mishra
[1]Center for Nanobiotechnology Research, Alabama State University
[2]Dept. of Materials Science and Engineering, University of Alabama at Birmingham
[3]Dept. of Biological Sciences, Alabama State University

Non-woven poly (caprolactone) (PCL) and hydroxyapatite (HA) nanofibers with different wt. % compositions were prepared by electrostatic co-spinning technology to mimic the nano-features of the natural extracellular matrix (ECM). The ECM is the natural medium in which cells proliferate, differentiate and migrate, and therefore is the gold standard for tissue regeneration. The morphology of the electrospun fibers was observed using scanning electron microscopy (SEM) and differential scanning calorimetry (DSC). The fiber diameter distributions were obtained by analyzing the SEM micrographs using image analysis software. FTIR confirmed the presence of HA in the fibers. The ability to grow cells on the scaffolds and the effect of incorporation of the cells on the toxicity of the scaffolds is under investigation. Preliminary studies were conducted on TRAMP-C1, C2, and C3 cell lines derived from transgenic adenocarcinoma mouse prostate (TRAMP) mice seeded on neat PCL and PCL with different percentage of HA for 24 hours at 37^{o}C with 5% CO_2. The scaffolds were analyzed by MTT assay at different time points to verify cell toxicity/proliferation. The data shows that the PCL is not toxic to TRAMP C1 cells while PCL with 1% HA gives better proliferation of TRAMP C1 cells suggesting that electrospun PCL provides an environment that supports cell attachment and proliferation.

UP-16. Optical Fiber Tip LSPR Biological Nanosensors

Mollye Sanders, Taylor Bono, Yongbin Lin, Krishnan Chittur, Robert Lindquist
Nano and Micro Device Center, University of Alabama in Huntsville

The capability of creating plasmonic nanostructures on the optical fiber tip with conventional nano-fabrication technologies would enable the transition of localized surface plasmon resonance (LSPR) based label-free biosensing technology from laboratory environment to field and space applications. The use of optical fiber platform for LSPR biosensing enables highly integrated and portable solutions for point-of-care applications in immunoassays and DNA hybridization assays. Multiple detections can be integrated into a single fiber bundle for parallel analyses. Moreover, this fiber probe is very suitable for remote sensing in space applications where savings in reagents are very valuable. In this report we present an approach to create arrays of metallic nanoantennas on the end facets of optical fiber utilizing planar substrate nanofabrication technologies such as electron beam lithography and lift-off processes. Compared to commercial surface plasmon resonance (SPR) sensing systems (Biacore AB), our proposed device offers several advantages, including (1) it can be inserted into the fluids and specimens for *in situ* chemical and biological detection, (2) the fiber device can be used as a SERS probe, a function not found in conventional SPR detection systems, and (3) it allows remote sensing. The fabrication methods allow rapid and inexpensive prototypes of nanostructures on optical fiber tip. Highly specific and sensitive detection of short strand DNA (ssDNA) using this fiber-optic label-free biosensor will be presented.

UP-17. Too Young for a Stroke? College Students` Perceptions about Stroke

Emmanuel Sims, Alicia Thomas, Adam Dodd
Southern University at Shreveport

A stroke, also known as a "brain attack", is a type of cardiovascular disease (CVD) that occurs when the brain is unable to get the blood it needs. While stroke most often occurs in older individuals, anyone can have a stroke at any time and at any age. There are two types of stroke: ischemic and hemorrhagic. Ischemic strokes are rare in individuals from 18 to

45 years of age, but can occur, with recent estimates of 4.9% of all strokes in the United States. Strokes can cause negative long-term physical and mental effects, most of which can be even more detrimental if presented during young adulthood. Young adults do not generally consider themselves at risk of having a stroke. However, many risk factors that can potentially lead to onset of stroke are common among college-aged individuals, including hypertension, obesity, migraine, diabetes, and smoking. Additionally, cardiovascular risk factors can present in young adulthood, increasing stroke risk. A recent population-based research study determined that substance abuse significantly increases the chance of stroke, and regular use of nicotine, cocaine, and alcohol have been proven to be associated with both ischemic and hemorrhagic stroke. Other drugs, such as amphetamines, have been associated with hemorrhagic stroke events. The purpose of this survey research was to assess the level of stroke awareness among college-aged students (aged 18 to 30).

UP-18. Stepping Through Virtual Communication into Virtmon

Gwendolyn Tennell
IUPUI Computer Science, Indiana University, Purdue University

While isolation is an important property from a security perspective, virtual machines (VMs) often need to communicate and exchange a considerable amount of data. Research in virtualization technology has been focused mainly on increasing isolation of co-resident virtual machines. The isolation properties of virtualization demand that the shared resources are strictly separated. The machine registers are also restricted; therefore virtual machines are forced to fallback to inefficient network emulation for communication. This research is based upon a stealthy way to communicate between virtual machines and virtual machine managers (VMMs) running on the Linux operating system. Virtmon is a paravirtualized virtual machine introspection (PVMI). It is a platform upon which users install and load a group of kernel modules. The Virtmon project utilizes the intra-to-exo channel to communicate stealthily between the virtual machine and its virtual machine manager, and the exo-to-intra channel to communicate stealthily between the virtual machine manager and the virtual machine, using a shadow region. The shadow region hides any activity between the machines and monitor which keeps malware from detecting and hijacking the communication between the two. The unrestricted PVMI framework shifts the challenges from bridging the semantic gap, to protecting and hiding the PVMI mechanism. Therefore, communication is secure, allowing undetected assistance from a privileged VMM to a VM. The Virtmon project has not only allowed the VMM to cross communication barriers undetected, but also allows for unrestricted registers, into which more data can be exchanged.

UP-19. Dissociation of U87-MG Glioblastoma Tumorspheres for *in vitro* Propagation of Cancer Stem Cells University of Alabama

Samantha G. Tilson and Yonghyun Kim
Chemical and Biological Engineering,
The University of Alabama

Cancer stem cells (CSCs) are unique subpopulation of cancer cells that have the ability to self renew and differentiate into various heterogeneous tumor cells. Previous studies showed that CSCs are enriched in tumorspheres in vitro when grown in suspension culture. If these spheres grow too large, however, diffusion limitation creates poor oxygen and nutrient environment in the center of the spheres that leads to cell death. Therefore, proper dissociation of tumorspheres into single cells is necessary to support continued propagation of CSCs in vitro. The goal of this project was to evaluate several methods of CSC dissociation that would induce minimal stress on the cells, produce high cell viability, and promote fast growth rate while not interfering with CSC activity. We tested five methods of dissociation: basic pH treatment; Trypsin and Accutase; Y-27632, a Rho kinase inhibitor; and mechanical trituration as control. U87-MG glioblastoma cells grown in serum-free, defined Neurobasal media were used as model CSC system. WST-8 proliferation assay and total viable cell counts were used to determine the effect of the treatments on CSC growth rate, and flow cytometry analysis of CD44 was used to determine any changes in cell-to-cell adhesion. Our results indicated that the tested methods yielded similar cell viability, growth rate, and CD44 expression. We therefore conclude that Accutase and Y-27632 treatments are viable alternatives to mechanical dissociation of CSCs.

UP-20. Investigation of the Hydrosilylation of Vinyl Pyridine with Trichlorosilane

[1]**Gabrielle Webber**, [2]Joshua Abbott, [2]Craig Barnes
[1]Alabama State University, [2]University of Tennessee

With the goal of creating multifunctional solid acid building block catalysts, the targeted incorporation of tethered pyridinium and imidazolium groups has been explored. The key aspect leading to such functionalized silicate matrices is the preparation of the ionic precursor via hydrosilation of vinyl prydine with trichlorosilane. The successful synthesis of the 4-(2-trichlorosilylethyl)prydine precursor without a traditional metal catalyst will be described.

UP-21. Effect of Firing Time on YSZ Microstructure for NOx Sensing

Dyamond Williams
Computer Science Dept., Southern University at Shreveport

A method was proposed to determine the effect of firing time on Yttria- Stabilized Zirconia (YSZ) microstructure for NO_x sensing. A scanning electron microscope (SEM) was used to take images so that calculations of the porous YSZ microstructure could be made. The SEM images were taken on 5mm X 10mm cut rectangular shape sensor with a porous YSZ structure. Sensor samples were fired over a temperature range of 950°C - 1050°C, for 1, 2, 4, 6 and 12 hours. A box furnace was used to fire the samples and SEM images were collected at room temperature. The data collected was at 3.0kv 4.6mm x 45.0kv on a 1.00μm scale and 3.0kv 4.6mm x 60.0kv, on a 500nm scale. The resolution of the 1.00μm generated more accurate porosity estimates. The YSZ tape was about 50 - 53% porous when fired at temperatures ranged from 950°C - 1050°C. The firing time seemed to have negligible impact on the porosity for the tape. Analysis of Variance (ANOVA), indicated no interaction between temperature and time data, and the P-Values for

temperature and time were 0.025907 and 2.27^{-5}, respectively. The ANOVA analysis identified a slight distinction between the time and temperature data suggesting both affected porosity since their p-values were less than, (<) the alpha (α) level of 0.05. Overall, it appeared that the firing temperature had a greater impact on porosity, in comparison to firing time. *The NSF EPSCoR Cooperative Agreement No. EPS-1003897 with additional support from the Louisiana Board of Regents.*

UP-22. Bandgap Engineered Zinc Iron Oxide Magnetic Nanoparticles for Biomedical Applications

Jeremiah F. Wilson, Sesha S. Srinivasan, Prakash C. Sharma
Dept. of Physics, Tuskegee University

The biomedical field has many uses for nanoparticles, such as targeted drug delivery, enhanced imaging in magnetic resonance imaging and small-scale tumor detection. Iron oxide nanoparticles are highly employed for the targeted drug delivery and early tumor diagnostic applications since their paramagnetic behaviors which are very compatible and responsive for MRI. However, the water corrosion behavior and reduced stability of these iron oxide nanoparticles mandates the discovery of other alternate materials. In search, zinc iron oxide, a spinal structure compound has proven to exhibit the superior magnetic properties and at the same time, very stable in water and/or air environments. Additionally, zinc iron oxides are non-toxic and can behave very benign for the prostrate cancer treatments and targeted drug delivery applications. In this study, zinc iron oxide ($ZnFe_2O_4$), a novel nanoparticle with particle sizes ranging from 1-10 nm has been synthesized using combinatorial synthesis involving mechanochemical and solvothermal processes. In the mechanochemical approach, a four station planetary milling of commercial ZnFe2O4 (~200 nm) was carried out under wet milling conditions by optimizing the amount of solvent medium such as methanol, ethanol or DI H2O. In the solvothermal route, a high temperature of ~180 ^{o}C was maintained for at least 24h to synthesize ZnFe2O4 nanoparticles from precursors of zinc chloride and iron chloride hexahydrate using bomb type ceramic crucible lined PARR pressure reactor. The physicochemical characteristics of these zinc iron oxide nanoparticles such as XRD, SEM, FTIR, UV-Vis, BET surface area analyses have been extensively carried out using state-of-the-art instrumentation tools.

Graduate Student Presentations

GP-01. Double Targeting Nanoscale Drug Delivery System for Treatment and Imaging of Metastatic Solid Cancers

[1]Md. Shakir Uddin **Ahmed**, [2]Mohamed O. Abdalla, [1]Timothy Turner
[1]Dept. of Biology & Center for Cancer Research, Tuskegee University,
[2]Dept. of Chemistry & Center for Cancer Research, Tuskegee University

As an alternative to the drawbacks of current advanced cancer treatments such as conventional chemotherapy, we propose a multifunctional double targeting drug delivery system that utilizes the combination of cancer-targeting peptides fused to amphiphilic polymer coated iron oxide nanoparticles (IONPs), and is loaded with suitable anticancer drugs as the payload. The PC3 human prostate cancer cell line will be used initially to test the efficiency of the proposed drug delivery system. Our target sites of choice are the luteinizing hormone releasing hormone receptor (LHRH-R) and the urokinase-type plasminogen activator receptor (uPAR), and doxorubicin was selected as the payload. A modified LHRH (ligand for LHRH-R) and AE105 (ligand for uPAR) were conjugated to IONPs according to the manufacturer`s protocol. Conjugated IONPs were characterized by gel electrophoresis and Dynamic Light Scattering (DLS). Prussian blue staining demonstrated that LHRH and AE105 conjugated IONPs were internalized by the PC3 cells. The drug loading and release capability of conjugated IONPs will be evaluated by HPLC. In addition the internalization of conjugated IONPs will also be examined utilizing Magnetic Resonance Imaging (MRI), and tumor eradication will be determined by MTT assay. We expect a significant enhancement in the binding efficiency of the LHRH-IONPs-AE105 to the prostate cancer cells, increased efficiency in tumor eradication, and better imaging and monitoring capabilities. Therefore, we believe the optimization of the proposed system will enhance targeted nanomedicine and significantly improve the health outcomes and quality of life for cancer patients because of its specificity to cancer cells and monitoring capabilities.

GP-02. Dendrimer-Templating: A Facile Fabrication Method for the Production of Bimetallic CuNi Nanoparticles

Md. Ariful Ahsan, Willard E. Collier, and Michael L. Curry
Department of Chemistry, Tuskegee University

The potential applications of metallic nanoparticles (NPs) as light absorbers in solar cells, storage media in technological devices, catalysts in catalytic reactions, and antimicrobials in biological systems have increased efforts in the development of novel methodologies to synthesize NPs with highly, controllable sizes, compositions, and morphologies. However, due to the high affinity of metal-to-metal interactions, size control and conglomeration of the formed NPs are difficult to control during the synthesis process. One promising method for the preparation of monodispersed metal NPs is the use of Poly(amido)amine (PAMAM) dendrimers as host templates, which can overcome limitations associated with traditional synthesis methods. In this work, we report the synthesis of monodispersed bimetallic CuNi nanoparticles with highly controllable sizes and composition. Using the chemical reduction approach, UV-Visible Spectroscopy shows that bimetallic CuNi NPs are formed within the interior cavities of the dendrimer structure. X-ray diffraction analysis confirms the presence of both Cu and Ni with a face-centered cubic crystal structure. TEM analysis confirms the production of spherical bimetallic NPs with an average size of 4.5 nm upon introduction of NaHB4, chemical reduction. *The authors gratefully acknowledge the National Science Foundation under Grant Nos. NSF EPS-1158862, NSF HRD-1137681,and Department of Chemistry for support of this research.*

GP-03. Biocompatible Polymer/Hydroxyapatite Electrospun Fibers for Bioengineering Scaffold Applications

[1]**Vitus Apalangya**, [1] Vijaya Rangari, [1]Shaik Jeelani, [2] Khalda Fadlalla, [2] Temesgen Samuel

[1]Department of Material Sciences, College of Engineering, and
[2]Department of Pathobiology, College of Veterinary Medicine, Nursing and Allied Health, Tuskegee University

The potential use of composite electrospun fiber scaffolds as substitutes for healing or replacement of human disease tissues and organs is gaining attention. The challenge is to design and engineer scaffolds which will structurally and functionally resemble the extracellular matrix (ECM) of the native tissues. The objective of our study is to fabricate electrospun composite fibers using poly(lactic acid) (PLA), infused with hydroxyapatite (HA) nanoparticles synthesized from eggshell and study their tissue supporting ability. The morphology, structure, mechanical and thermal properties of the PLA/HA, composite nanofibers will be studied using the following techniques; field emission scanning electron microscopy (FE-SEM), energy dispersive spectrum (EDS) spectroscopy, X-ray diffraction (XRD), Fourier transform-infrared (FT-IR) spectroscopy. The initial studies on as-synthesis of HA nanoparticles from eggshell show that the particle sizes are in nanoscale (20-50 nm) and the shape is platelet which is ideal for tissue growth. The diameter of the electrospun fibers ranges from 10-1 μm suitable for cell growth and attachment. The energy dispersive spectrum (EDS) confirmed the inclusion of the nanoparticles on the surface of the nanofibers. The optical microscope and histology images showed the growth of ATCC CRL-11372 cells on the fibers. *Research was supported by NSF EPS-1158862, CREST: HRD-1137681.*

GP-04. *Chlamydia trachomatis* PLGA-Encapsulated Subunit Mucosal Vaccine

D'Andrea Ashmore, Stacie J. Fairley, Saurabh Dixit, Shree R. Singh, Vida A. Dennis
Center for NanoBiotechnology Research, Alabama State University

Chlamydia trachomatis, the most reported sexually-transmitted bacterial pathogen worldwide, can cause ectopic pregnancy, infertility, and increase susceptibility to other infectious organisms. Despite all research efforts there is no vaccine against C. trachomatis, which perhaps maybe due to ineffective delivery systems. Our research is focused on nanoparticles as delivery systems to develop efficacious subunit mucosal vaccines against Chlamydia. We employed Poly D, L-lactic-co-glycolic acid as a delivery vehicle and interleukin (IL)-12 as an adjuvant for the recombinant major outer membrane protein (MOMP) of C. trachomatis (rMOMP). The rMOMP and IL-12 were individually encapsulated within PLGA resulting in preparations of PLGA-rMOMP and PLGA-IL-12, respectively and a single PLGA-IL-12-rMOMP subunit nanovaccine. We hypothesized that encapsulated IL-12 will enhance the capacity of encapsulated-rMOMP to induce desirable T-helper (Th1) immune responses in BALB/c mice. Our hypothesis was tested by immunizing mice with PLGA-IL-12-rMOMP and comparing their induced Th1 cellular and antibody immune responses with those induced in mice immunized with PLGA-rMOMP and Chlamydia. The physio-structural characterizations of PLGA-rMOMP and PLGA-IL-12 by several techniques revealed encapsulation efficiency of 60% and 90, respectively and sizes of ~100-500 nm. Spleen cells from mice immunized with PLGA-IL-12-rMOMP produced higher rMOMP-specific Th1 cytokines (IFN-ϒ and IL-6) and chemokines (CXCL1 and CCL3). Also, higher systemic IgG and IgG2a (Th1) than of IgG1 (Th2) rMOMP-specific antibodies were produced in PLGA-IL-12-rMOMP immunized mice. Overall, our data shows that PLGA-IL-12-rMOMP triggered robust immune responses, suggesting the adjuvant effect of encapsulated-IL-12. We are currently evaluating the efficacy of PLGA-rMOMP-IL-12 and its immune effectors in mice.

GP-05. Sequential Graft-IPNs of Polyurethane and Vinyl Ester

Ricardo A. Ballestero, Maria L. Auad
Polymer and Fiber Engineering, Auburn University

In recent decades, a fast growing branch in the field of polymers has attracted the attention of the public and safety industry due to its promising results. Interpenetrated polymer networks (IPN), which are a blend of polymers, seek to combine the best properties of two or more different polymer networks in order to achieve a material with better properties compare to their not-interpenetrated counterparts. There has been an increasing interest in developing IPNs in which the two networks are chemically cross-linked. These chemically cross-linked IPNs also known as graft-IPNs, possess remarkable mechanical properties. The enhancement in their mechanical properties can be attributed to the cross-linking of the networks. The graft-IPNs synthesized consisted of a copolymer and polyurethane phase. The copolymer phase was synthetized using two different acrylates, methyl methacrylate (MMA) and triethylene glycol dimethacrylate (Tri-EDMA) with the inclusion of the vinyl ester, bisphenol A-glycidyl methacrylate (BisGMA), and the polyurethane phase was synthetized using two dyols: 1,1,1-tris(hydroxymethyl) propane (TRIOL) and poly(tetramethylene ether) glycol (PTMG) average Mn ~ 650 g mol-1 and 1400 g mol-1. To obtain information about the mechanical properties of the graft-IPNs, a three-point dynamic mechanical analysis was preformed. The transparency of the samples was measured by UV-visible spectrophotometry. The results showed transmittance values between 75 and 90%. As for the dynamic mechanical analysis, the variable that had the biggest influence in the material final mechanical properties (storage modulus, EΘ, and tan Θ) was found to be the variation of the copolymer to polyurethane ratio.

GP-06. Synthesis and Characterization of Anti-Human Respiratory Syncytial Virus Peptide RF-39 Encapsulated Chitosan – Poly (Lactic Acid Glycolic Acid) Nanoparticles

Swapnil Bawage, Pooja Tiwari, Vida Dennis, Shree Singh
Center for NanoBiotechnology Research, Alabama State University

Worldwide, human respiratory syncytial virus (RSV) is one of the leading causes of lower respiratory tract infections in children and old adults. Currently, an anti-viral drug ribavirin and RSV neutralizing monoclonal antibody- palivizumab are the only relief options, but the problems associated with them are their cost and adverse effects. Nanotechnology has greatly contributed in the pharmaceutics, especially, in the case of delivering drugs. Nano-encapsulation of drugs provides the advantage of longer retention and controlled release, thereby increasing the efficacy. RSV infects host cells by RSV F protein mediated cell membrane fusion. There are many compounds that are being developed for a potent, safe and cost effective anti

RSV drug. Chemical or protein fusion inhibitors that block this vital step in RSV infection are considered good anti RSV target. In this study, RSV F protein derived RF-39 peptide (a fusion inhibitor) was characterized and modeled; also its interaction with RSV F protein was studied. RF-39 was double encapsulated with biodegradable polymers, firstly by poly [lactic acid-glycolic acid] (PLGA) and then by chitosan, to form nanoparticles. The size and charge of nanoparticles were determined by zeta sizer (differential light scattering) and zeta potential, respectively. Electron microscopy was performed to determine shape and size of the nanoparticles. Fourier transformation infra-red spectroscopy was also done to confirm the encapsulation. Cytotoxic concentration of these nanoparticles for HEp-2 cell lines was determined by MTT assay. The study validates the use of RF-39 peptide against RSV and characterizes the chitosan-PLGA nanoparticles and anticipates RSV inhibition studies.

GP-07. Antimicrobial Activity of Peptides Conjugated with Gold and Silver-Coated Gold Nanoparticles

Courtnee Bell, Kauser Hussain, Shanese Jasper, Kasha Casey, Vida Dennis, Shree Singh,
Shreekumar Pillai
Center for NanoBiotechnology Research, Alabama State University

Silver (Ag) and Gold (Au) nanoparticles (np) are becoming increasingly popular as antibacterials and antimicrobial nanocomposites, but they are toxic to cells. Metal nanoparticles can be combined with antimicrobial peptides to decrease toxicity and potentially increase antibacterial properties. We evaluated the antimicrobial properties of gold and silver-coated gold nanoparticles, and peptide TP557 against Salmonella enterica serovar Typhimurium and Streptococcus pyogenes using the Kirby-Bauer Disc Diffusion Assay and the Minimum Inhibitory Concentration (MIC). When 100 µg/mL, 200 µg/mL, 300 µg/mL and 350 µg/mL of the Au-np were used to inhibit Salmonella, the zones of inhibition (ZI) were 16mm, 18mm, 20mm, and 20mm respectively, as compared to a ZI of 32mm when the broad spectrum antibiotic amoxicillin-clavulinic acid was used. The ZI of peptide TP557 against Salmonella was 22mm at a concentration of 350 µg/ml. The MIC for TP557 against Salmonella was between 50 and 62.5 µg/ml. The MIC for TP557 against Streptococcus was between 50 and 62.5 µg/ml. The MIC for the Au-np against Salmonella was between 100 and 200 µg/ml, whereas against Streptococcus it was between 50 and 100 µg/ml. The interaction of TP557, TP359, Au-np, Ag-coated-Au np and their conjugates with bacterial cells will be further investigated by Atomic Force Microscopy (AFM), standard plate count, genomic and proteomic studies.

GP-08. Polyvinyl Pyrrolidone (PVP) Coated Silver Nanoparticles Demonstrates a Capsule Dependent Antimicrobial Effect against *Streptococcus pneumoniae*

Ronda K. Bibbs, SR Singh, VA Dennis,
Mamie Coats
Center for Nanobiotechnology Research & Biological Sciences Department, Alabama State University

Both the antimicrobial nature and toxicity of metals are well documented in literature. Advances in nanotechnology have extended the usefulness of metals as antimicrobials while decreasing their toxic effects. Our study examined the effectiveness of metallic nanoparticles on the growth of pathogenic *Streptococcus pneumoniae*. The need for novel antimicrobials which can control pneumococcal growth is becoming more pressing due to increasing numbers of isolates which are resistant to current therapies. Nanospheres of gold (AuNP), titantium dioxide (TiO_2), or polyvinyl pyrrolidone (PVP) coated silver (Ag-PVP) were tested for their ability to inhibit the growth of the pneumococcal model strain D39. Of the formulations test, Ag-PVP was found to be the most effective and provided the most consistent results. The inhibitory effect of Ag-PVP was seen for serotypes 4, 19F, and 3 in addition to serotype 2. The examination of S. pneumoniae strains that completely lack a capsular polysaccharide showed that the lack of the capsule made bacteria more resistant to the action of Ag-PVP. These data demonstrate a serotype independent, capsule dependent bactericidal activity for metallic nanoparticles includes of *S. pneumoniae*. *This work was supported by NSF-CREST (HRD-1241701) and NSF-HBCU-UP (HRD-1135863) at Alabama State University, Montgomery,AL.*

GP-09. Manipulating Adsorption of Ionomers in Layered Double Hydroxides

LaDena Bolton and Ishrat Khan
Dept. of Chemistry, Clark Atlanta University

Studies of layered double hydroxides, or LDHs, are targeted in biomedical research due to the ease of intercalating organic species and the added control over its dimensions. These clays have been studied in applications including drug delivery. LDHs are brucite-like materials, with formula [M2+1-xM3+x (OH)2]x+(An-)x/nmH2O. M2+and M3+are metal cations and An- represents the interlayer anion which balances the positive charges between layers. Sulfonates serve as a model to study the anionic exchange capacity and structural properties between organic guest molecules and LDH. The gap in structures ranging from small molecules to macromolecular electrolytes neglects to illustrate adsorption trends among partially charged polymers. The short term objective of this work is to study the competitive adsorption behavior of Mg_2Al $(OH)_6$ NO_3-mH_2O with partially charged polystyrene at various sulfonation levels. We are testing the hypothesis that charge density and particle size of an ionomer affects Mg_2Al-LDH`s affinity to adsorb multiple sulfonated hydrocarbons simultaneously. The polymers were prepared by anionic polymerization, followed by sulfonation, resulting in polystyrene sulfonic acid (HPSS). Pure LDHs were prepared from a mixed salt solution maintained between pH 8-11 with the addition of 2M NaOH. The polymer-LDH nanocomposites were also prepared by co-precipitation in the presence of one or two HPSS samples. This work was analyzed using TGA, LS, and NMR. Thus far, we have found that 13% PSS-LDH is the most favorable nanohybrid for drug delivery. It is the most stable composite, has the smallest particle size, and allows incorporation of multiple organic compounds simultaneously.

GP-10. Enhancing Delivery of Tyrosine Kinase Inhibitors in Drug Resistant Tumors

[1]Terrisha Buckley, [1]Gemechu Wirtu, [2]Roopali Mittal, [1]Ebony Brockett, [1]Rupak Chowdhary, [3]Komal Vig, [4]Zhe-Sheng Chen, [1] Amit K. Tiwari

[1]Department of Biomedical Sciences, College of Veterinary Medicine, Nursing and Allied Health, Tuskegee University; [2]Miami Children Hospital,[3]Center for NanoBiotechnology Research, Alabama State University; [4]Department of Pharmaceutical Sciences, College of Pharmacy and Allied Health Professions, St. John's University

Human epidermal growth factor receptor (HER/EGFR) tyrosine kinase inhibitors (TKIs) such as erlotinib, lapatinib, BCR-ABL TKIs such as nilotinib, imatinib and vascular endothelial growth factor inhibitor (VEGF) TKI such as sunitinib are clinically used in a variety of neoplastic conditions. Recently, we found that specific TKIs could enhance the sensitivity of traditional anticancer agents in multidrug resistance (MDR) cancers-mediated by overexpression of ATP-binding cassette (ABC)-transporters. In our efforts to further enhance the delivery of these targeted anticancer drugs, we assessed a panel of clinically used TKIs, lapatinib, erlotinib, sunitinib, imatinib and nilotinib and compared their potency to modulate and sensitize anticancer activity of doxorubicin and paclitaxel *in vitro.* Nilotinib was found to most potently sensitize specific anticancer agents by blocking the functions of ABCB1/P-glycoprotein, ABCG2/BCRP and ABCC10/MRP7 transporters involved in MDR. Nilotinib appreciably enhanced the antitumor response of (1) paclitaxel in the ABCB1- and novel ABCC10-xenograft models, and (2) doxorubicin in a novel ABCG2-xenograft model. Nilotinib attenuated tumor growth synergistically and increased paclitaxel concentrations in ABCB1-overexpressing tumors. These insights are exciting and are now used to further optimize pharmacotherapy with TKIs even in most resistant cancer. We are in a process of encapsulating TKIs with paclitaxel, doxorubicin, individually in biodegradable nanomaterials for enhanced sustained delivery in well-established drug resistant models. Translational significance of these anticancer agents lies in developing a targeted combination strategy with pharmacokinetic and pharmacodynamics [PK/PD] parameters in mind, which will lay the foundation for a clinical trial to further optimize pharmacotherapy. *The authors like to thank Dr. A. Eljack, Chairperson, Biomedical Sciences and Dr. T. Habtemariam, Dean of School of Veterinary Medicine, TU for their continued support. Dr SR. Singh, Director Center of Nanobiotechnology Research (NSF-CREST HRD-0734232), ASU support to Dr. Vig. This work in part is also supported by RCMI Core grant number (G12MD007585-23); Department of Pharmaceutical Sciences, SJU support to Dr. Chen; and Department of Biomedical Sciences, TU support to Dr. Wirtu and Dr. Tiwari.*

GP-11. Superparamagnetic Iron Oxide Nanoparticles as Drug Delivery Vehicles

[1]Kasha Casey, [1]Pooja Tiwari, [2] Michal Miller, [1]Shree R. Singh, [1]Komal Vig

[1]Center for NanoBiotechnology Research, Alabama State University; [2]Auburn University

In recent years, nanotechnology has emerged as one of the most promising fields for biomedical applications and healthcare. The use of nanoparticles has earned much attention due to their small size, high surface area to volume ratio along with surface charge, and their optical and semiconducting properties. Superparamagnetic iron oxide nanoparticles (SPIONs), which show superparamagnetism, have been reported to be reliable and safe for many biological applications. This property can be exploited for various purposes including drug delivery to targeted tissues. In the present study, 10nm SPION were loaded with anticancer drug, Docetaxel. Docetaxel conjugation to SPION was confirmed by FTIR, UV-vis spectroscopy and gel electrophoresis. SPIONs uptake by cells was investigated using Prussian blue dye staining. *In vitro* drug release was studied which showed 55% drug release in 24 h. SPIONs and drug toxicity to cell lines were tested using MTT assay. SPIONs showed 80% cell viability to HEp-2 cells at 100 μg/ml in 48 hours whereas drug alone was very toxic to HEp-2 cells reducing cell viability to 20%. Drug loaded SPIONs were then tested on mammary tumor cells (4T1) and showed 55% cell viability with 0.1M Docetaxel conjugated to SPIONs. The results indicate that reduced concentration of Docetaxel is needed to treat 4T1 cancer cells when it is conjugated to SPIONs.

GP-12. Synthesis and Characterization of Poly (Urea-Formaldehyde) Microcapsules for Self-Healing Polymer Composite

Reaz A. Chowdhury, Mahesh V. Hosur, Alfred Tcherbi-Narteh, Md. Nurrudin, Dereca Watkins, Ashok Kumar, Jonathan Trovillion, Shaik Jeelani

Materials Science and Engineering, Tuskegee University

Fiber reinforced polymer (FRP) composite materials have shown promising result as replacement for traditional materials in structural applications. During service, issues of repairs due to damage caused by projectiles can be very challenging, leading to limitation and short life span. The concept of self-healing composites can be a way of overcoming this limitation and extending the life expectancy, while expanding their usages in structural applications. Self-healing concept can be intrinsic or extrinsic where external stimulation is required to activate the process of self-healing. In the current study, the extrinsic self-healing concept was adapted using urea-formaldehyde microcapsules containing room temperature curing epoxy resin system (SC-15) as the healing agent prepared by in-situ polymerization. Microcapsules were characterized using Fourier Transform Infrared Spectroscopy (FTIR) for structural analysis. Size and shape of microcapsules was studied using optical microscopy and Scanning Electron Microscopy (SEM). Size of the microcapsules was between 30-100 μm. Thermal characterization was carried out using thermogravimetric analysis. Microcapsules were thermally stable till 210 °C without any significant decomposition. Finally, kinetics analysis for thermal decomposition of encapsulated epoxy and empty capsules were done for determination of activation energy by Kissinger method which was 121 and 116 kJ/mol respectively.

GP-13. Physical, Mechanical, and the Recyclability Characteristics of Nanocellulose Based Bio-composites for Sustainable Electronics

Kristy Crews, Chemar Huntley, Michael Curry

Materials Science and Engineering, Tuskegee University

Globally, the usage and reliance on electronics to complete the simplest tasks has increased significantly in the last decade. With a decreasing life span and an increase in ownership of technological devices, worn or redundant electronics eventually end up in environmentally unfriendly locations (e.g., incineration, importation, or landfills). Improper disposal or recycling of electronics leads to environmental and human damages, especially in developing countries. Although processing of these used computers creates low income jobs, the cons of the trade, in used computers, are palpable. Eventually, a portion of all used electronics end up in either landfills or the backyard of a child`s home in some underdeveloped countries. Thus, it is of great urgency that new methods of fabricating bio-degradable or recyclable technological devices are investigated. Thus the objective of this research is three-fold: 1) identify and characterize suitable polymers and nano-reinforcers such as, ABS, HIPS, and nanocrystalline cellulose (NCC) respectively, 2) explore the effect of Nanocellulose on ABS and HIPS loading, and 3) modify the nature of the nanocomposite interactions via modification of the NCC. *The authors gratefully acknowledge the National Science Foundation under Grant Nos. NSF EPS-1158862, NSF HRD-1137681, and NSF IGERT on Sustainable Electronics DGE-1144843 for support of this research.*

GP-14. Investigation of Carbon Nanofiber Infused Carbon/Epoxy Composites

Morgan Perry Davis Jr., Mahesh Hosur, Shaik Jeelani
Materials Science & Engineering, Tuskegee University

Carbon nanoparticle incorporated carbon/epoxy laminates have gained tremendous interest in the past decade. This is because of the nanoparticles superior mechanical, electrical, thermal, and morphological properties when compared to other materials. Even with the improved properties the incorporated nanoparticles create, the laminates fail to completely meet the expectations of researchers. The dissatisfaction of researchers stem from the major issues of poor dispersion of the carbon nanoparticles and the poor interfacial bonding within the laminates. The goal of this research is to develop fiber reinforced laminates by dispersing carbon nanofibers (CNFs) in high temperature EPON 862 epoxy and utilize these composites in aerospace applications. This is addressed by dispersing the CNFs, 0.5 wt. % and 1.0 wt. %, in the epoxy using a combination of sonication and calendaring techniques. Carbon/epoxy composites were fabricated using hand layup and compression mold process at a cure cycle of 121oC for 4 hrs. Dynamic mechanical analysis (DMA) was performed at a rate of 5 ^{o}C/min from room temperature to 220 ^{o}C to analyze viscoelastic properties. Results show a linear increase in glass transition temperature but in contrast, a decrease in storage modulus as CNF content increased. This is attributed to the poor bonding between the CNFs and epoxy.

GP-15. Silver Coated Carbon Nanotubes Inhibit a Mucoid Strain of *Pseudomonas aeruginosa*

E. Dosunmu, K.Vig, M. Coats,V. Dennis, S. Singh, S. Pillai
Center for NanoBiotechnology Research, Alabama State University

Pseudomonas aeruginosa is an opportunistic Gram-negative pathogen causing respiratory infections in cystic fibrosis patients, that adapts to harsh environments by switching from a non-muocid to a mucoid state. This mucoid state caused by overproduction of alginate, may also be associated with antibiotic resistance. Previous studies have shown that silver coated carbon nanotubes (AgCNT) inhibit several pathogens. In this study we have tested the inhibitory activity of AgCNT against a mucoid strain of *P. aeruginosa* by the Kirby-Bauer disk diffusion assay exposed and the minimum inhibitory concentration (MIC) assay. The Kirby Bauer Disk Diffusion Assay showed that AgCNT concentrations of 400 µg, 300 µg, 200 µg and 100 µg inhibited *P. aeruginosa* growth with clear zones of 12mm, 11mm, 10mm and 7mm respectively. Quantitative analysis of P. aeruginosa measuring colony forming units (CFU) after exposure to the nanotubes showed more than 50% inhibition at 60 µg/ml by 8h with little increase in inhibition by 16 h, while at 75 µg/ml inhibition was nearly 70% by 16h, and at 100 Âµg/ml inhibition was over 70% by the 12 h. These results suggest that AgCNT have a bacteriostatic effect against the mucoid strain of *P. aeruginosa*. Future studies on morphologic, genomic and proteomic changes may help to elucidate the mechanism of inhibition.

GP-16. Nanotube and Graphene Sensors for Cancer Biomarker Detection

Pedro Ducos, Mitchell B. Lerner, Jimson D. Souza, Tatiana Pazina, Jennifer Dailey, Brett R. Goldsmith, Matthew K. Robinson, A. T. Charlie Johnson
Dept. of Physics and Astronomy, University of Pennsylvania

We developed a novel method for cancer biomarker detection. Devices are fabricated by attaching a genetically engineered single-chain variable fragment (scFv) protein that is designed to match the specific biomarker to either a carbon nano-tube field-effect transistor (NT-FET) or a graphene field-effect transistor (Gr-FET). Chemical functionalization can be done using two distinct processes that may be applied to either transistor. First, we used diazonium salts (chemically activated and stabilized) to covalently attach the scFv to the NT-FET; second, we used the bi-functional molecule 1-pyrene butanoic acid succinimidyl ester (PYR-NHS) to non-covalently attach the scFv to the Gr-FET. Amine groups of the scFv protein bind to the N-Hydroxysuccinimide (NHS) group that results from either functionalization step. Binding is confirmed by Atomic Force Microscopy (AFM) and effects are shown through Raman Spectroscopy. A concentration dependent increase in the source-drain current is observed in a range of clinical significance. The functionalization steps described here are expected to be generalizable for any scFv antibody that contains accessible amine groups for binding.

GP-17. Flexure and Viscoelastic Properties of Sodium Bentonite Nanoclay Incorporated EPON 862 Nanocomposites

Masuma Ema, Shaik Zainuddin, Abdullah Fahim, M. V Hosur, E. Moura, J.D. Tyson, S.Jeelani
Material Science and Engineering, Tuskegee University

The aim of the this work was to investigate the mechanical and thermomechanical properties of Epon 862 resin composites modified with different wt. % loading of inorganic sodium bentonite (NAOB) nanoclay. Samples were fabricated using 0.5-2 wt. % NAOB using high amplitude ultrasonic processor and

diethyl toluene diamine curing agent. X-ray diffraction (XRD), dynamic mechanical analysis (DMA) and 3-point bend tests were conducted to determine the nanoclay dispersion, viscoelastic and flexure properties. A peak shift and intensity reduction in nanoclay infused epoxy samples in comparison to pure NAOB indicated a mixed intercalated and exfoliated behavior. Optimum enhancement in viscoelastic properties was found at 1 wt.% NAOB loading with a significant increase of 24 degree Celsius and 22% in glass transition temperature (Tg) and storage modulus, respectively. A similar linear increment of 43% and 41 % was observed in flexural strength and modulus of 1 wt. % NAOB loading. However, at 2 wt. % loading, both viscoelastic and flexural properties were reduced in comparison to 1 wt. % counterpart. Poor dispersion at 2 wt. % evident from high intensity XRD peak and smoother fracture surfaces lead to decrease in these properties suggesting a need for more effective nanoclay dispersion methods.

GP-18. Improvements in Mechanical and Thermal Properties of Halloysite Nanotubes Filled Biodegradable PHBV(Biopol) Nanocomposites

Abdullah Fahim, Shaik Zainuddin, Masuma Ema, Mahesh V. Hosur, Shaik Jeelani
Materials Science & Engineering, Tuskegee University

The aim of this study was to find the effect of halloysite nanotube (HNT) on the thermal and mechanical properties of poly(hydroxybutyrate-co-hydroxyvalerate) "PHBV" nano composite films. Various concentration of HNTs (1-3 Wt. %) were added in the PHBV polymer by melt processing and films were fabricated using compression mold process. X-ray diffraction, differential scanning calorimetry analyses were performed along with tensile tests. XRD results showed intercalation and/or exfoliation of HNTs in the PHBV matrix with increase in inter planar spacing and decrease in peak intensity confirming a good dispersion state of HNTs in the polymer matrix. DSC analysis showed that the crystallinity of the polymer increased with increase in HNT concentration. Also, the DSC endotherm curve showed dual melting peaks indicating formation of different crystalline phases. Higher melting and recrystallization temperature was found in nano phased films in comparison to pure PHBV counterpart. Tensile test results of the nano composite films showed enhancement in tensile properties with increasing HNT loading. Micrographs revealed river like pattern in pure films indicating brittle pattern in contrast rougher surfaces observed in nano phased films.

GP-19. Phage Fusion Proteins as Targeting Ligands in LipoDox for Lung Cancer Treatment

James W. Gillespie, Lixia Wei, Valery A. Petrenko
College of Veterinary Medicine, Auburn University

Cancer remains of the largest health burdens in global healthcare, with lung cancer being one of the primary contributors to mortality. One significant technology to combat various types of cancer has been the development of liposomal nanocarriers which carry different types of traditional chemotherapies like doxorubicin. The use of liposomal nanomedicines has resulted in a significant increase in favorable patient outcomes. However, accumulation of these nanomedicines within the tumor is based on the leaky vasculature of the tumor and the EPR effect. It has been hypothesized that targeting these nanomedicines specifically to tumors can result in significant increases in accumulation and reduce non-specific uptake within non-neoplastic cells. We hypothesize that phage display could be used to identify ligands that can be incorporated into liposomal doxorubicin (LipoDox). We selected phage that interact with lung cancer cells and characterized their uptake into a non-small cell lung cancer (NSCLC) cell line. Phages that show specific interactions to cancer cells were identified and used for cancer targeting. We isolate phage proteins and insert the whole major coat protein spontaneously into preformed LipoDox. These cancer-specific LipoDox nanomedicines were tested *in vitro* for uptake of doxorubicin and subsequent increase in cytotoxicity after treatment in NSCLC cells. We show that phage fusion proteins specific for cancer cells can be used to specifically target liposomal drugs to specific cell types depending on the incorporated targeting ligand.

GP-20. Comparing the Dispersions of Commercial Single-Walled Carbon Nanotube Products in Unsaturated Polyester Resin

Joyanta Goswami and Virginia A. Davis
Dept. of Chemical Engineering, Auburn University

Using carbon nanotubes to improve polymer properties has an on-going area of research. However, while many thermoplastic polymers have been investigated, most of the work on thermoset polymers has focused on epoxy resins. Even though unsaturated polyester resin (UPR) has a much higher market share than epoxy, there has been very little research on UPR/nanotube composites. We report the dispersion of various commercial, unfunctionalized, single-walled carbon nanotubes (SWNT) in an isophthalic polyester resin. The resin used was Polylite 31830 which has a polyester content of 70.5 wt% and styrene content of 29.5 wt%. All dispersions were prepared using high shear mixer and characterized by optical microscopy and rheology. Optical microscopy provides qualitative information about network formation and the presence of aggregates while rheology provides quantitative information about the dispersion microstructure. At a given concentration, the dispersion microstructure was significantly affected by the specific SWNT grade suggesting that the polymer-nanotube interactions are dependent on the specific SWNT type. Since final composite properties are significantly affected by dispersion microstructure, these dispersion variations suggest that the specific SWNT type may have a significant effect on final composite properties.

GP-21. Aligned Cellulose Nanocrystal Films for Bio-MEMS Applications

Alexander D. Haywood, Christopher L. Kitchens, R. William Ashurst, and Virginia A. Davis
Department of Chemical Engineering, Auburn University

Bio-based nanomaterials such as cellulose nanocrystals (CNC) are increasingly being recognized for their potential in advanced materials applications. Produced by acid hydrolysis from natural cellulosic materials, CNC have garnered this attention due to their exceptional mechanical and chemical properties as well as their inherent renewability and abundance. Many CNC are known to follow lyotropic liquid crystalline phase behavior, and form a cholesteric phase when dispersed in water above the

critical concentration. The cholesteric polydomain structure of the CNC dispersion can be preserved in a dried film. However, when sheared, "unwinding" of the cholesteric pitch occurs and aligned films can be prepared. Alignment of CNC in the films opens the possibility to create material with anisotropic properties. This potential is of particular interest for microelectromechanical systems (MEMS) and is not possible with current silicon technology. It has been well established for other rod-like nanomaterials that a greater degree of alignment can be achieved from liquid crystalline dispersions than from biphasic or isotropic dispersions. Therefore, the initial dispersion microstructure plays a critical role in determining coating properties. Investigations on the rheology and phase behavior of aqueous CNC dispersions have been used to develop processes for making CNC films with controlled properties. We report on how the interplay between dispersion microstructure and shear affect the morphology of CNC films. These results provide a foundation for functional CNC films, particularly for application in MEMS devices.

GP-22. Low Doses of Iron-Oxide Nanoparticles have a Detrimental Effect on Reproduction and Development

Benjamin W. Henderson, Hunter Dean, Rami R. Ajjuri, Yuping Bao, Janis M. O`Donnell
Dept. of Biological Sciences, The University of Alabama

Biomedical applications of nanoparticle technology, such as targeted drug delivery and medical imaging, are rapidly expanding. Generally, the safety of nanoparticles is assessed by toxicity analysis of cultured cells. Such models, however, do not fully reflect potential interactions in living organisms. Therefore, detailed toxicological assessment of nanoparticles in whole organisms is needed for comprehensive evaluation of potential deleterious effects. We are utilizing Drosophila melanogaster, a well-studied model organism, to develop appropriate assays for immediate and long-term consequences of nanoparticle exposure. In the current study, we evaluated the effects of transient and low-dose treatment of negatively-charged, polyacrylic acid-coated and positively-charged, polyethylenimine-coated iron oxide nanoparticles. Drosophila larvae were fed a range of concentrations for 24 hours and assessed for lethality, pupation success, and eclosion rate (the rate at which flies successfully made it to adulthood). Surviving adults were then assayed for reproductive defects. Additionally, hemocyte levels of treated larvae were quantified to determine whether or not nanoparticle exposure triggered activation of the innate immune response. We find that a specific range of low-concentration treatment to nanoparticles results in reproductive deficits as well as the induction of an immune response. We anticipate that this complex, whole-organism model will provide researchers the capability of assessing the adverse effects of nanoparticle exposure.

GP-23. Interfacial Improvement of Nanopahsed Jute Fiber Reinforced Green Composites by Surface Modification

Mohammad K. Hossain, Md. Mahmudur R. Chowdhury, Mohammad W Dewan , Mahesh Hosur, and Shaik Jeelani.
Mechanical Engineering, Tuskegee University

Extensive research efforts are currently on progress all over the world to develop and characterize green composites with high performance at an affordable cost due to the growing environmental awareness. Biodegradable nanophased jute composites were manufactured using chemically treated jute fabrics, Biopol, and nanoclay using compression molding process for this study. Nanoclay infusion into the thermoplastic is a challenging issue and was infused using solution intercalation technique. Surface modification of jute fibers was accomplished by performing subsequent chemical treatments such as detergent washing, dewaxing, alkali and acetic acid treatment. Morphology of modified surfaces was studied using SEM and FTIR. Thermal performance of treated fibers was studied using TGA. Thermal, dynamic mechanical and mechanical properties of biodegradable nanophased jute composites were evaluated by TGA, DMA and flexure test respectively. Enhanced thermal and mechanical properties were observed in modified and nanophased jute biopol composites.

GP-24. Synthesis, Modification, and Characterization of Crystalline Cellulose Derived from Agricultural Waste Products

Chemar J. Huntley, Kristy D. Crews, and Michael L. Curry
Materials Science and Engineering,Tuskegee University

Interest in the biodegradability of natural products for use in electronics has rapidly increased over the years with a special focus on crystalline cellulose-based composites. Cellulose is an abundant, natural polymer that possesses great strength and biodegradability, which makes it an ideal candidate as reinforcement fillers in electronics. In this study, crystalline cellulose was extracted from purified wheat straw via strong acid hydrolysis with sulfuric, nitric, and hydrochloric acids. A comparison of the surface and structural differences of the polymer caused by the varying acids were examined with x-ray diffraction analysis and scanning electron microscopy. To increase the hydrophobicity of crystalline cellulose, the Jones oxidation reaction was used to modify the cellulosic structure. Subsequently, mechanical and thermal properties of the neat and modified polymers were investigated allowing additional insight into the characteristic improvements or regressions. *The authors gratefully acknowledge the National Science Foundation under Grant Nos. NSF EPS-1158862, NSF HRD-1137681, and NSF IGERT on Sustainable Electronics DGE-1144843 for support of this research.*

GP-25. Effect of Electron Beam Radiation Induced Cross-Linking on Nylon-6/TiO2 Composite Fiber

[1]**M.A. Imam**, [2]M.G. Gomes, [2]E. Moura, [1]S. Jeelani , [1]V.K.Rangari
[1]Department of Materials Science and Engineering, Tuskegee University
[2]Instituto de Pesquisas Energeticas e Nucleares-IPEN, Sau Paulo, Brazil

Polyamides (Nylon-6) are engineering plastic with excellent properties which are useful in several industrial applications and are valued for their high strength and processability. The addition of filler such as TiO_2 to form molded composites has increased the range of polyamide applications due to the resulting increase in strength. The effect of electron beam radiation on these thermoplastic nanocomposites are either increases the cross linking or causes chain scission. In this study, TiO_2 were infused in Nylon-6 polymer through a melt extrusion process to form nanocomposite fibers that were tested for their

mechanical and thermal properties (e.g. tensile and differential scanning calorimetry). These composites were further exposed to the electron beam radiation (160kgy,132 kgy and 99 kgy) and tested for their thermal and mechanical properties. The ultimate tensile strength is found to be 600 MPa for radiated TiO_2 /Nylon-6 single fibers as compared to 254 MPa for TiO_2/Nylon-6 single fibers without radiation and 240 MPa for neat Nylon-6 single fibers respectively. Differential scanning calorimetry (DSC) analysis results show the decrease of crystallinity are as expected at high dosages of electron beam radiation. These initial studies clearly show the effect of electron beam radiation on these composite fibers are promising. The further studies to understand the positive and negative effects of these electron beam radiation dosages are under progress.

GP-26. Low Velocity Impact Characterization of MMT/MWCNT Hybrid Nanoparticle Modified Carbon/Epoxy Composites Subjected to Marine Environmental Conditioning

Md Ekramul Islam; Tanjheel Hasan Mahdi; Mahesh V Hosur; Alfred Tcherbi-Narteh; Shaik Jeelani
Materials Science and Engineering, Tuskegee University

The use of carbon fiber reinforced polymeric composites for naval vessels has been increasingly recently, where highly impact resistance is a major concern. In this study, low velocity impact response of carbon fiber reinforced epoxy nanocomposites modified with Multiwalled Carbon Nanotube (MWCNT), Montmorillonite (MMT) nanoclay and MWCNT/MMT hybrid nanoparticle while subjected to marine environmental conditioning were investigated. Carbon/Epoxy composites reinforced with 0.3% loading of COOH-MWCNT, 2% of MMT and 0.1% MWCNT/2% MMT hybrid nanoparticles by weight of epoxy were tested and the results are compared with the neat carbon/epoxy composite. Dry samples without degradation were tested first and compared with degraded samples. The composite laminates were subjected to 30J, 40J and 50J energy levels and energy, load and velocity response with respect to time and displacement were obtained. The damage area for all modified and control samples were observed using thermographic imaging technique and quantified with a program written in MATLAB. From experimental results it is evident that, MWCNT and MMT reduced the damaged area of composite panels and enhanced the impact properties. But significant improvement was observed for the hybrid nanoparticles reinforced composite panels. The samples were subjected to 1 month, 3 months and 6 months degradation. 1 month degradation data for different samples were compared and presented here.

GP-27. Preparation and Characterization of Calcium Citrate from Waste Egg Shell as a Source of Calcium Supplement

Samia Islam, Vijaya K. Rangari, Shaik Jeelani
Material Science & Engineering, Tuskegee University

The treatment of bio waste and to utilize for the environment is completely commendable and would be very economic. Every year more than 45 million kg of egg shells waste are dumped in the United States without any further processing. Egg shell mainly consists of calcium carbonate (95%) and rests are the organic matrix. Calcium carbonate is a good source of calcium supplement for the human body but the separation of calcium carbonate from egg shell is complicated due to its insolubility with most of the solvents and in acid solution it loses the property. Now a day`s calcium citrate is also used as calcium supplement. Calcium citrate supplement might be better because it dissolves better than calcium carbonate so the human body can absorb more calcium from calcium citrate. In this work calcium citrate was produced from the egg shell using citric acid. And the egg shell membrane, egg proteins were successfully taken out from the calcium source in the egg shell. The prepared calcium citrate from egg shell was characterized by XRD and FTIR. Thermal properties were investigated by using TGA.

GP-28. Antibacterial Effectiveness of Peptide TP373 Against Salmonella and Staphylococcus

[1]**Shanese L. Jasper**, [1]S. Kauser Hussain, [1]Courtnee R. Bell, [2]Mona Bakeer, [1]Vida A. Dennis, [1]Shree R. Singh, [1]Shreekumar R. Pillai
[1]Center for NanoBiotechnology Research, Alabama State University
[2]Therapeutic peptides Inc., Baton Rouge, LA

Antimicrobial resistance is a global concern. As alternatives, silver nanoparticles are widely used due to their known antibacterial properties. However, the nanoparticles are also toxic. The use of antibacterial peptides to functionalize metal nanoparticles may decrease the toxicity and provide enhanced antibacterial function. In this study, the antibacterial effects of TP373, a proprietary peptide from Therapeutic Peptides Inc. have been investigated using *Salmonella enterica* serovar Typhimurium and *Staphylococcus aureus*. TP373 was shown to have a dose dependant effect with MICs between 100 - 125 µg/ml for both bacteria. The Kirby-Bauer disc diffusion method showed a zone of inhibition (ZOI) of 0.30 cm and 0.32 cm for *S. enterica* ser. Typhimurium and *Staphylococcus aureus* respectively, when 100 µg/ml of TP373 was used. When a concentration of 300 µg/ml was used, the ZOI increased to 0.50 cm for *Salmonella typhimurium* and 0.55 cm for *Staphylococcus aureus*. 30 Âµg/ml of amoxicillin/clauvulanic acid, used as a positive control, gave a ZOI of 1.7 cm. MTT assay results show no signs of cytotoxicity at the concentrations required for bacteristatic or bactericidal effects. These preliminary results show that TP373 has potential as an effective antimicrobial agent. Future work will include conjugation of TP373 to functionalize silver nanoparticles and evaluation of the antibacterial properties of the conjugate as well as ultrastructural, genomic, and proteomics.

GP-29. Deformation Mechanisms and Strength of Metallic Nano-Laminates with Semi-Coherent Interfaces

Mohammad Rezaul Karim, Firas Akasheh
Mechanical Engineering Department, Tuskegee University

Although metallic nano-laminates are known to have ultra high strength on the order of GPa, a complete understanding of the deformation mechanism responsible for this behavior are not completely understood. In this paper we investigate dislocation deformation mechanism for (100) semi-coherent fcc/fcc Cu/Ni nano-laminates with individual layer thickness of 2.5 nm under uniaxial loading conditions. Since atomic level processes govern the behavior at this length scale, we use molecular dynamics to perform our analysis. Besides observing dislocation reactions, the relationship between stress and strain as well as histories of

the density of different dislocation types and intrinsic stacking faults are inspected. From our observation, the majority of misfit dislocations which exist at the interfaces in the initial relaxed structure dissociate into shockley partials and stair rod in the early stages of loading. Remaining misfit dislocations undergo nonconventional slip in the (100) interface plane and react with partials resulting in the nucleation of new partials. From the analysis of the stress-strain curve, initial hardening comes from forest type dislocation interaction between partials. Then dislocation crosses the interface at 2.5 GPa stress level with less significant resistance. Formation of dislocation locks as a result of partial dislocation interactions also serve as a barrier to dislocation propagation. Later on, nucleation of trailing partials reduce defect density.

GP-30. Opto-Microfluidic Sensors Based on Bias Voltage Driven Liquid Crystal Orientational Transitions at Aqueous Interface

Dan Ke and Robert Lindquist
Electrical and Computer Engineering, The University of Alabama in Huntsville

Recently, biosensors fabricated with liquid-crystal (LC) materials have enabled label-free observations of biological phenomena at aqueous interfaces. In this effort, we hoped to significantly improve the limits of the sensitivity of LC-based sensors to targeted analytes by integrating our efforts of monitoring the changes in anchoring energy and microfluidc systems. Microfluidic systems offer a strong platform for cost effective, high throughput biosensing applications. Monitoring changes of liquid crystal (LC) anchoring energy and orientations at the LC-aqueous interface with bias voltage can improve sensitivity, response time and signal strength of LC-based chemical and biological sensors significantly. Two structures for the microfluidic device are designed. The influence of a bias voltage at the LC-aqueous interface is analyzed theoretically.

GP-31. The Synthesis and Characterization Of β-Cyclodextrin-Poly(ethylene glycol)-Folic Acid: A Drug Delivery Vehicle for Anti-Tumor Therapeutics

Ishrat Khan and **Janet V. Cowins**
Dept. of Chemistry, Clark Atlanta University

Beta-Cyclodextrin (β-Cyclodextrin) has been widely used as a host molecule for encapsulating a variety of guest drugs. While the exterior of this molecule is hydrophilic because of the primary and secondary hydroxyl groups located on the upper and lower perimeter of the moiety, the cavity of β-Cyclodextrin is hydrophobic. These unique characteristics enhance β-Cyclodextrin`s solubility and make it an ideal carrier for hydrophobic drugs. Additionally, functionalization of β-Cyclodextrin with the appropriate groups permits site specific drug delivery to its desired location. Phytosterols are plant sterols that have been shown to exhibit anti-cancer properties. We hypothesize that the β-Cyclodextrin-Poly-(ethylene glycol)-Folic Acid (β--CD-PEG-FA)/ β--Sitosterol bio-conjugate will be an efficient tumor-specific complex for drug delivery. Since most tumor cells over-express folate receptors, inclusion of folic acid in the construct of the vehicle will direct phytosterols to tumor sites. To understand and determine the stability of the bio-conjugate drug delivery vehicle, we have studied the vehicle using various instrumentations which include IR (Infrared Spectroscopy), NMR (Nuclear Magnetic Resonance Spectroscopy) and DSC (Differential Scanning Calorimetry). NMR studies reveal a broad peak on Î²-Cyclodextrin at the OH-6 position indicating that the functionalization of the molecule with PEG was accomplished. Additionally, FT-IR and DSC studies also indicate the formation of a stable drug delivery vehicle with increased functionalization of the Cyclodextrin molecule. These initial studies suggest that this polymeric bio-conjugate has the potential to be utilized as a target specific anti-tumor drug delivery vehicle.

GP-32. Discussion on Transmembrane Proteins Fused in Lipid Bilayer Membrane Supported on Both Sides of Porous Silicon

Muhammad S. Khan, Khalid H. Tantawi, Noura S. Dosoky, Bakhrom Berdiev, John D. Williams
Electrical and Computer Engineering, The University of Alabama in Huntsville

Membranes are vital structures found everywhere in the biological system. Since last decade nanotechnology has been contributing significant role to understand the physiology and properties of lipid bilayer membranes (LBMs) fused with transmembrane proteins. Currently different porous structures have been introduced at nanoscale and multiple efforts are underway to fuse LBMs with proteins that are deposited on an artificial template using polymer sponges or porous materials such based on alumina, mica, and porous silicon (PSi) surfaces. Porous silicon material has high biocompatibility, biodegradability and photoluminescence which allow it to be used both as a support structure for LBMs fused with proteins or a template to measure the electrochemical functionality of living cells grown over the surface as *in vivo*. Small pores are introduced to achieve lower surface coverage and to increase the life time of membranes. Discussion on incorporated proteins with LBMs when they interact with surfaces will be presented at a wide range of frequencies using electrochemical impedance spectroscopy (EIS) technique. EIS shows physical behavior of LBM in terms of its resistance and capacitance at different frequency ranges which is helpful for investigating the life time of pore spanning LBM on porous substrates and this methodology confirms the mechanical stability of membrane. This research will conclude the importance of porous silicon structures which keep the different transmembrane proteins fused in LBM deposited on each side of PSi in an environment as close as possible to the *in vivo* one.

GP-33. Nano-Gap Surface Plasmon Resonance Perfect Light Absorber Sensor

Wonkyu Kim, Junpeng Guo
Dept. of Electrical and Computer Engineering, University of Alabama in Huntsville

We investigated and experimentally demonstrated a surface plasmon resonance perfect absorber in infra-red wavelength. The perfect light absorber consists of an array of gold disks on a nano-scale layer of aluminum nitride on a thick gold film. The calculated absorption is over 99% at the normal incidence and continues to be very high over a large angle of incidence. The nanostructure device has multiple surface plasmon resonant modes resulting in strong absorption in several wavelengths. Absorption wavelengths stay constant with respect to the change

of incident angle for a few resonance modes. The strong wavelength selective absorption from the nanostructure device offers great potential for biochemical sensor applications.

GP-34. Inhibitor of Differentiation 4 Protein (Id4) Nanotherapy for Prostate Cancer

Maxwell Korang-Yeboah, Divya Patel, Ashley Evans, Pankaj Sharma, Ravi Palaniappan, Jaideep Chaudhary
Dept of Pharmaceutical Science, Mercer University

Purpose of the study was to assess the effect of nanoparticle delivered Inhibitor of differentiation 4 protein on growth and tumorigenicity of prostate cancer. Id4 loaded nanoparticle was formulated using two biocompatible materials: Polycaprolactone and Maltodextrin. The double emulsion solvent evaporation technique was employed using a Nano Dbee high pressure homogenizer. The nanoparticle were characterized for size, shape and the presence of intact Id4 using light scattering, western blot and circular dichroism. Western blot and Immunocytochemical analysis was conducted on nanoparticle treated cell lines (LNCaP-Id4 and DU145) to evaluate the efficiency of the nanocarrier as a delivery vector. The effect of nanoparticle delivered Id4 on cellular processes such as cell cycle and apoptosis was then assessed by Propidium iodide and Annexin V/Propidium Iodide kits using the Accuri C6 flow cytometer. Cell transwell migration and anchorage independent growth assays was also performed after nanoparticle delivery of I d4 into the cells. Id4 loaded PCL/Maltodextrin nanoparticles was successfully formulated containing intact protein as revealed by the Western blot analysis and circular dichroism. Immuno-cytochemical and western blot analysis of the cell lines showed an efficient intracellular delivery of Id4 using PCL/Maltodextrin with possible intra- nuclear localization of Id4. Intracellular delivered r-Id4 blocked cell cycle and increased the percentage of cells undergoing apoptosis by three fold. The number of migratory cells decreased from an average of 504 cells to as low as 124 post Id4 nanoparticle treatment. The ability of the prostate cell lines to grow independent of an anchor was also significantly reduced after intracellular delivery of Id4. Intracellularly delivery Id4 using polymeric nanocarrier reduces tumorigenic potential and increased cell death in prostate cancer.

GP-35. Engineering of Polymeric Vesicles for the Treatment of Lysosomal Storage Disease

Jessica Larsen, Douglas R. Martin, Mark E. Byrne
Department of Anatomy, Physiology, and Pharmacology in the College of Veterinary Medicine and the Department of Chemical Engineering in the Samuel Ginn College of Engineering, Auburn University

Delivery of therapeutics to the brain through noninvasive administration is a difficult task due to the presence of the blood-brain barrier (BBB). Molecules of less than 500 Daltons and with less than 8 hydrogen bonds are transported through the brain endothelium. However, these metrics do not encompass the size ranges and physical properties of drugs. We are designing and characterizing self-assembling polymeric vesicles, or polymersomes, for the purpose of encapsulating and delivering treatment for GM1 gangliosidosis through intravenous methods. Polymersomes have high physiological stability and tunable properties that, when coupled with an osmotic diuretic or brain endothelium specific receptor, could facilitate delivery through the BBB and into the lysosome of neural cells. With water as a solvent, polyethylene glycol-b-poly(lactic acid) copolymer has been proven to self-assemble, forming vesicle structures at an average size of 216.2 nm ± 12.9 nm when at a concentration of 0.1 - 0.2 wt%. After lyophilization for increased long-term stability, the polymersomes maintain the integrity of their hydrophobic membrane if freeze-dried immediately following cryogenic freezing of the solution. This polymer-based technology has the potential to encapsulate and deliver drugs through the BBB with controlled release mechanisms and high levels of stability.

GP-36. Preparation of Organic Molecules with Planar Geometry for the Modification of Carbon Nanotubes

Laurenee London, Ke Feng, Xiu R. Bu
Department of Chemistry, Clark Atlanta University

Much attention has focused on finding ways to better disperse SWNTs by attachment of molecules to the SWNT sidewalls to optimize their properties. The solubilization and functionalization of SWNTs by non-covalent means, is preferred especially because the direct and covalent functionalization of SWNTs would affect the pristine surface of the nanotube, thus potentially leading to undesirable properties. Small molecules such as porphyrin attached to the surface of SWNTs via π-π stacking interaction is an approach that enables the introduction of various functional groups onto its surface, and at the same time, that leads to achieve desirable solubility and processability. Therefore the carbon nanotubes will have the ability to assist in biomedical applications, national defense, advanced electronics, and many more.

GP-37. Role of Polymer Stereoregularity on Nanocomposites of Polystyrene with Single-Walled Carbon Nanotubes

Laurisa A. London, LaDena Bolton, Duminda K. Samarakoon, Vernecia Person , Biswajit San-nigrahi, Xiao-Qian Wang, Ishrat Khan
Dept. of Chemistry, Clark Atlanta University

Significant enhancement of the physical and mechanical property of polystyrene materials is accomplished with the addition of single-walled carbon nanotube (SWNT) nanofillers at low loadings. When determining composite formation, the geometry of the nanofiller is usually preferentially considered; whereas the orientation of the polymer chain is commonly neglected. This study uses a combination of theoretical and experimental methods to elucidate the effects of polystyrene stereoregularity on polymer/SWNT composite formation. Computational study and differential scanning calorimetry (DSC) show that isotactic polystyrene is most effective in complexing with the SWNT. At low SWNT content isotactic polystyrene nanocomposite is best depicted by type A matrix with well dispersed SWNTs throughout the matrix. The atactic polystyrene is less effective in complexing with SWNTs in matrix type C. At low SWNT content in matrix type C there is significant agglomeration. Solution NMR spectroscopy and solid state 13C T1Ï data supports the computational and DSC results; thereby validating the formation of type A and type C matrices. These results suggest that the isotactic polystyrene is a better charge donor to the SWNT compared to the atactic polymer, and the spatial arrangement of the polymer repeating unit at the

molecular level plays a significant role in the formation of nanocomposites.

GP-38. Fabrication and Characterization of Biodegradable Cellulose Nanofibers Reinforced Epoxy Nanocomposites

Tanjheel Hasan Mahdi, Md. Nuruddin, Mahesh V. Hosur, Shaik Jeelani

Material Science and Engineering, Tuskegee University

Polymers are being modified with nanoparticles to enhance their mechanical, thermal and thermo-mechanical properties. In this work, cellulose nano-fibers (CNFs) from renewable and biodegradable source were extracted and incorporated in epoxy resin at 1 wt. %, 2 wt. % and 3 wt. % to fabricate nano-composites. Nano-composites were then subjected to flexure testing, dynamic mechanical analysis and thermogravimetric analysis. Morphological study was conducted with scanning electron microscope. Addition of CNFs in epoxy shown significant improvement in thermal and mechanical properties compared to those of control ones. Best results were obtained for 2 wt. % addition of CNFs in epoxy. Nano-composites modified with 2 wt. % nanoparticles exhibited about 14% increase in storage modulus as well as 17° C increase in glass transition temperature. Flexural modulus for 2 wt. % nanoparticle modified polymers depicted about 30% improvement compared to control ones. An increase of about 20° C in decomposition temperature was also observed. Therefore, an enhancement of mechanical, thermal and thermo-mechanical properties was achieved by incorporating CNFs to polymers.

GP-39. Adeno-associated virus-mediated gene therapy provides long-term stabilization of neurologic disease

[1,2]**Victoria J. McCurdy,** [1,2] Allison M. Bradbury, [1]Heather L. Gray-Edwards, [3]Aime K. Johnson, [1]Ashley N. Randle, [1]Misako Hwang, [1]Nancy E. Morrison, [1,2]Patricia M. Beadlescomb, [2]Brandon L. Brunson, [4]Nancy R. Cox, [5]Miguel Sena-Esteves, [1,2]Douglas R. Martin

[1]Scott-Ritchey Research Center, Depts of [2]Anatomy, Physiology and Pharmacology, [3]Clinical Sciences, [4]Pathobiology, Auburn University College of Veterinary Medicine

[5]Gene Therapy Center, University of Massachusetts Medical School

Lysosomal storage diseases (LSDs) have an incidence of 1 in 7700 births and are characterized by mutations in genes encoding lysosomal proteins required for degradation of cellular substrates. GM1 and GM2 gangliosidosis (GM1 and GM2) are LSDs caused by deficiency of the ganglioside catabolizing enzymes β-galactosidase and Hexosaminidase, respectively. The resulting accumulation of ganglioside inside lysosomes of the central nervous system causes progressive neurodegeneration and death, often in infancy. Adeno-associated virus (AAV)-mediated gene therapy has the potential to provide a permanent source of deficient enzyme and has proven successful in gangliosidosis mouse models. Prior to initiation of clinical trials, gene therapy must be tested in large animal models with a size more closely resembling humans. We engineered AAV serotype 1 or rh8 vectors to encode functional β-galactosidase or Hexosaminidase cDNA. The therapeutic vectors were injected bilaterally into the thalamus and deep cerebellar nuclei of pre-symptomatic GM1 and GM2 cats. Sixteen weeks post-treatment enzyme activity against synthetic chromogenic and fluorogenic substrates was restored to near or above normal levels throughout the entire CNS, and ganglioside storage was substantially reduced in all areas. In long-term therapeutic experiments, 9 AAV-βgal treated GM1 cats currently range in age from 24.4 to 47.8 months and show only mild or no clinical disease symptoms (untreated survival, 8.0±0.6 months). Quality of life was also substantially improved in AAV-Hex treated GM2 cats with survival up to 35.7 months (untreated survival, 4.4±0.6 months). Our AAV-mediated gene therapy approach has proven the most promising experimental treatment to date for gangliosidosis.

GP-40. Cyclic RGD Functionalized Nanodiamonds and Nanodiamond/Doxorubicin Loaded Poly (lactide-co-glycolide) Nanofibers for Targeted and Sustained Drug Delivery

Roberus McIntos, Amanee Salaam, Ashlen Kurre, Vinoy Thomas, Mohamed Abdalla, and Derrick Dean

Materials Science and Engineering, The University of Alabama at Birmingham

Biomedical Engineering, The University of Alabama,

Department of Physics, The University of Alabama at Birmingham

The utilization of nanodiamonds in the field of drug delivery possesses many advantages. Theyâ€™ve been shown to be chemically inert, biocompatible, and their high surface area allows for the absorption of drugs, such as chemo, to their surface. Also, when carboxylated, nanodiamond-based systems can be functionalized with various proteins, antibodies, and other biomolecules which can give them the ability to target, image and deliver chemo to specific sites in the body, such as cancer cells, thus reducing toxicity at healthy sites and increasing the drug dosage at malignant sites. This fact, along with their ability to transfect the cell membrane has been shown to make chemo more effective when combined with the nanodiamonds as oppose to using the drug alone. Our primary goal in this study is to develop a composite drug delivery system composed of electrospun PLGA [poly(lactic-co-glycolic acid)] polymer nanofibers and detonation nanodiamonds that give a controlled and sustained release of doxorubicin as a function of polymer degradation time and weight percent nanodiamond loading. This project will also consist of the synthesis and characterization of detonation nanodiamonds with cyclo arginine-glycine-aspartic acid (RGD) peptide, which will be used to selectively target the alphaVbeta3 integrin that is over-expressed in tumor angiogenesis and certain types of cancers. This research has the potential to impact the way chemotherapy drugs are administered and to enhance the overall quality of localized cancer treatment

GP-41. Novel MicroRNA Based Therapy for Pulmonary Hypertension

[1]**J.M. McLendon**, [1] S.R. Joshi, [2] M. Matar, J.G. Fewell[2], [1] M. Oka, [1]I.F. McMurtry, [1]W.T. Gerthoffer

[1]University of South Alabama,

[2]EGEN Inc., Huntsville

Background: Pulmonary hypertension (PH) is a condition caused by pulmonary vasoconstriction and vascular remodeling which progresses to heart failure and premature death. Our previous work demonstrates increased microRNA-145 expression in

lungs from PH patients and rats with experimental PH. If increased miR-145 expression is necessary for pulmonary arteriopathy, then inhibiting miR-145 might reverse arteriopathy and improve cardiovascular function. Methods: To test this we induced severe PH in rats using Sugen-5416 and chronic hypoxia and administered a single stranded LNA/DNA oligomer designed to antagonize miR-145. We used mPEG-lipopolyamine-based nanoparticles (Staramine) to enhance uptake and retention of antimiR-145 in lungs. Results: Three biweekly intravenous injections of antimiR-145/staramine in the PH rats reduced expression of miR-145 in lungs and significantly improved metrics of pulmonary arteriopathy including arterial wall thickness and the frequency of occluded vessels. Echocardiography and hemodynamic measurements showed improved cardiovascular function, comprising decreased right ventricle systolic pressure, reduced pulmonary resistance, and increased cardiac output. Significantly, antimiR-145/staramine had no effect on systemic blood pressure, or evidence of toxicity using comprehensive metabolic panels. Conclusion: Our results support the conclusion that inhibiting miR-145 can reverse pulmonary arteriopathy and improve cardiovascular function. These dramatic improvements strongly support the potential for using novel microRNA based therapy for clinical PH. *Research support from HL097220 to (WTG) and stipend support from HL076125 to (JMM).*

GP-42. Comparison of the Effects of D2A Peptide Loaded CaCO3 NPs Derived from Organic and Inorganic Sources on Cell Viability in Cancer Cell Lines

[1]**Myisha Roberson Moore**, [1]Vijaya Rangari, [2] Clayton Yates, [2]Jesse Jaynes, [1]Shaik Jeelani
[1]Dept of Materials Science and Engineering, [2]Dept of Biology, Tuskegee University

Chronic cutaneous ulcers are problematic for those suffering from autoimmune diseases (Panuncialman & Falanga, 2010). These ulcers are wounds that do not close, do not heal or are constantly reoccurring strongly due to malnutrition, or comorbidity. Chronic cutaneous ulcers are usually arrested in the inflammatory phase of wound healing causing pain, increased chance of infection and loss of tissue function (O`Meara, 2000; Frank, Bayoumi, & Westendorp, 2005; Panuncialman & Falanga, 2010). During this phase, elevated levels of proteinases are thought to be a key factor in the impaired healing of a variety of chronic ulcers (Hart, Silcock, Gunnigle, & Cullen, 2002; Frank, Bayoumi, & Westendorp, 2005). In an effort to promote closure of chronic cutaneous ulcers, we employ the novel technologies of peptide therapy and nanomedicine as a treatment option. Closure of a chronic ulcer decreases probability of infection, results in pain relief and improves the ability of tissue function. In this study, we evaluate the ability of our biodegradable peptide-loaded calcium carbonate nanocarrier system (AS D2A/$CaCO_3$ NPs) to effect cellular viability in cancer cell lines, a disease model. We compare the use our nanocarrier system which uses calcium carbonate nanoparticles derived from eggshells, an organic source, to a similar nanocarrier system which uses commercially purchased, inorganic calcium carbonate nanoparticles (MK D2A/$CaCO_3$ NPs). Preliminary results of this study show our AS D2A/$CaCO_3$ NPs have superior activity to the nanocarrier system using commercial, inorganic nanoparticles. Results of this *in vitro* study, in addition to other studies involving our D2A peptide-loaded $CaCO_3$ NPs, may predict the beneficial use of this system as a treatment option.

GP-43. Comparison of Morphology, Crystalline and Thermal Properties of Cellulose Nano-Fibers Isolated from Wheat Straw by Acid Hydrolysis and Ball Milling

M. Nuruddin, Alfred T. Narteh, M. Hosur, S. Jeelani
Materials Science & Engineering, Tuskegee University

Objective of this work was to compare morphology, crystalline and thermal properties of cellulose nano fibers derived from wheat straw by two different processes (ball milling and acid hydrolysis treatment). The fractionation of cellulose and lignin from wheat straw included formic acid, peroxy formic acid treatment and hydrogen peroxide bleaching. 39.1% cellulose, 20.4% lignin and 25.02% of other compounds were extracted. The isolated celluloses were then subjected to acid hydrolysis or ball milling to isolate cellulose nano-fibers (CNFs). Acid hydrolysis was carried out using 64% sulfuric acid at 60 ^{o}C for 60 minutes under constant stirring. In the case of ball milling, isolated celluloses were milled using ethanol as solvent at different time intervals of 30 minutes, 60 minutes, 2 hours and 3 hours. The characterization of extracted CNFs was done by scanning electron micrograph (SEM), transmission electron microscopy (TEM), X-ray diffraction (XRD), thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC). It was found from morphological and thermal analyses that ball milled cellulose nanofibers have similar properties as obtained from acid hydrolysis
such as diameter of nano meter ranges (10-25 nm), 70-80 % crystallinity and decomposition temperature of around 360 ^{o}C.

GP-44. Mechanisms of Nano-encapsulated Interleukin-10 Modulation of *Chlamydia trachomatis* Inflammation

William Okeke, Abebayehu Yilma, Saurabh Dixit, Praseetha Subbarayan, Shree R. Singh, Vida A. Dennis
Center for NanoBiotechnology Research, Alabama State University

Interleukin-10 (IL-10) is an anti-inflammatory cytokine produced by various cell types including macrophages and dendritic cells. IL-10 displays an array of biological activities and has been shown to inhibit the synthesis of inflammatory mediators and prevent tissue damage both *in vitro* and *in vivo*. It is, therefore, an effective therapeutic agent to control chronic inflammatory diseases including those induced by bacterial pathogens. *Chlamydia trachomatis*, the leading cause of bacterial sexually transmitted infections, invades the mucosal surface of the female genital tract after its major outer membrane protein (MOMP) is recognized by cell surface receptors, consequently triggering the production of inflammatory mediators.Increasing evidence now suggests that these inflammatory mediators, which are produced by persistently infected cells, contribute to Chlamydia pathogenesis. Here we demonstrate that IL-10 inhibited inflammatory mediators (IL-1b, IL-6, IL-12p40 and TNF) produced by mouse J774 macrophages, in response to MOMP stimulation. Because IL-10 has a short half-life, we next encapsulated it within PLGA-chitosan nanoparticles. Our hypothesis is that encapsulating IL-10 within nanoparticles will prolong its anti-inflammatory effect. Encapsulated IL-10 diminished the production level of TNF

triggered by LPS in macrophages over a 72 hr period. Moreover, IL-10 induced the expression of the suppressor of cytokine signaling (SOCS) 1 and 3 proteins in macrophages, which were further enhanced by the addition of LPS, suggesting that SOCS may be potential mediators of the anti-inflammatory actions of IL-10. Future studies will explore the role of SOCS proteins in the IL-1-mediated inhibition of *C. trachomatis* inflammation using siRNA and SOCS knockout mice.

GP-45. Synthesis of Graphene/Ag Hybrid Nanoparticles for Multifunctional Woven Carbon Fiber Nanocomposites

Chinedu Okoro, Vijaya Rangari, Shaik Jeelani
Material Science and Engineering, Tuskegee University

The use of composites to supplement heavier, dense structural materials with composite structures having multifunctional capabilities has steadily inclined over the past decade. Epoxy resins are being widely used in a multitude of composite applications namely acting as the polymer matrix of high performance composite materials. However, a major limitation in these thermoset systems is that they produce highly brittle materials when nanoparticles are used as fillers. For this reason toughening mechanisms have been studied extensively throughout the past decades. A vegetable oil based product (Linseed oil) and EP9009 are used as a plasticizer and additive to commercial polymers to improve their toughness, tensile strength and biodegradability. In addition, these resin systems are typically insulators and do not possess conductive capabilities. Subsequently, technologies that enable conductivity and multifunctional capabilities are of major interest within defense initiatives, particularly aerospace. Therefore, a conductive composite material with multifunctional properties toughened with biodegradable components was fabricated. Autogenic pressure reaction and microwave (CEM) synthesis was used to fabricate conductive graphene-Ag hybrid nanoparticles. Chemical vapor deposition (CVD) was then performed to grow conductive carbon based nanoparticles onto the surface of commercially available woven carbon fiber. A multifunctional composite was then fabricated using the bio-modified epoxy system. Quantitative thermal, electrical and mechanical tests were conducted to characterize and assess material properties.

GP-46. Preparation of DNP-Functionalized Poly (2-Hydroxy Ethyl Methacrylate) with Poly (3-Decylthiophene) as Macroinitiator and Preliminary Biocompatibility Evaluation with Anti-DNP IgE

Omotunde Olubi
Dept of Chemistry, Clark Atlanta University

The use of block co-polymers as active components in biosensors and other nanoscale devices has been an area of intense focus in the last decade or so. One way of achieving this is the functionalization of the polymers with appropriate ligands that are capable of binding to high affinity receptors (FcÎµRI) on the surface of mast cells or Immunoglobulin E (IgE) for instance. Consequently, we have synthesized block co-polymers of 3-decylthiophene with 2-hydroxy ethyl methacrylate via atom transfer radical polymerization, ATRP. The macroinitiator, Poly (3-decylthiophene) was first made by Grignard metathesis reaction followed by a series of end group modification to yield the bromoester end-capped polymer. ATRP of 2-hydroxy ethyl methacrylate was carried out in dimethylformamide (DMF) with CuBr/PMDETA (catalyst/ligand) duo to yield the co-polymers which were then functionalized with DNP-Îµ-amino-n-caproic acid. Characterization of the co-polymers was done by 13C and 1H NMR, FTIR, UV-Vis and Raman spectroscopy. Thermal analysis was done by differential scanning calorimetry, and thermo gravimetric analysis. Electrical behavior was studied via cyclic voltammetry. The co-polymer solution in chloroform was drop-cast on to silicon substrates to form films whose morphology was studied using electron and scanning probe microscopy techniques. Biocompatibility studies, done through incubation in fluorescently tagged IgE indicated that there was preferential binding of the protein to the dinitrophenyl (DNP) groups, as observed under the fluorescence microscope. The results obtained so far, strongly indicate that these block co-polymers have potential use in biosensors, with the incorporation of specific functional groups that antibodies recognize and attach to.

GP-47. Durability Studies of Hybrid Composite of E-Glass/Carbon Fibers in Different Media for Bridge Deck Panel Application

Peter S. Owuor, Mahesh .V. Hosur, A. Tcherbi-Narteh, S. Jeelani
Materials Science and Engineering, Tuskegee University

An experimental study was carried out to investigate the moisture absorption of two types of epoxy systems, SC- 15 and 635 thin epoxy resin in different media. These resins were infused into Carbon, E- Glass and hybrid fibers of Carbon and E-Glass. The different media used for degradation test were saltwater, water, gasoline, anti-freeze and engine oil. Thin 635 epoxy system showed better flexural properties in both Carbon fiber and hybrid composite but poor results when used as a matrix for E-Glass fibers. Flexural properties for conditioned samples were later performed after an immersion period of 8 weeks at room temperature and results followed the same trend as unconditioned samples where 635 epoxy performed well in all the media except in gasoline. There was degradation of flexural properties for all conditioned samples. Moisture absorption curves did not follow the Fick's law of diffusion expect in water. Gasoline exhibited the highest moisture absorption in both types of the resin system. Thin 635 epoxy resin demonstrated lower moisture absorption compared to SC-15 epoxy resin in all media expect gasoline.

GP-48. Synthesis of Bio Based Calcium Aluminate for Mechanical and Thermal Improvements in Dental Applications

Delicia E. Peoples, Vijaya Ranagri, Shaik Jeelani
Materials Science and Engineering, Tuskegee University

Calcium carbonate ($CaCO_3$) is extensively used for a variety of applications including paper production, plastics, coatings, calcium- enriched foods, drug delivery, and bone regeneration. Bio-based calcium carbonate is used because of its ability to be: Bio-compatibility, biodegradability, pH sensitive, the large interfacial area which can entrap liquids via adsorption. One of the easiest sources of bio based calcium carbonate is from chicken egg shells. They have higher nutrient contents of calcium, magnesium, phosphorous, collagen, polypeptides and amino acids. These compositions of eggshell make a suitable

dental filling material compared to the synthetic $CaCO_3$. Recently, researchers have considered the use of calcium aluminate for dentistry because of its ability to increase the mechanical and thermal properties and are bio-compatible. In this research, the calcium carbonate and aluminum oxide are mixed using a 1:1 ratio through mechanical attrition. The mixture is heated to 1300°C for 3 hours under argon atmosphere to produce calcium aluminate and byproducts. Samples are analyzed using X-ray diffraction (XRD) and scanning electron microscope (SEM). The calcium aluminate samples are re-ball milled and sonicated to reduce particle sizing. A common dental restorative composite resin, 50/50 Bisphenol A glycerolate dimethacrylate (Bis-GMA/TEGDMA), is cured using a photo-initiator and Halogen blue curing light. The calcium aluminate is mixed with the dental resin to determine the mechanical and thermal properties of the material and compared to standard properties. All samples were analyzed using scanning electron microscope (SEM), differential scanning calorimetry (DSC), thermogravimetric anaylsis (TGA), compression and flexural testing.

GP-49. The Effect of Metallic Nanoparticle-Antibiotics Conjugates on the Viability of Pneumococci

Veolanda A Peoples, Rhonda Bibbs, Shree R. Singh, Mamie T. Coats

Center for NanoBiotechnology Research, Alabama State University

Streptococcus pneumoniae is a highly recombinagenic respiratory pathogen which remains a major cause of morbidity and mortality worldwide in spite of available vaccines and antibiotics. *S. pneumonia* `s adaptable nature along with its natural competence both contributes to the need for novel antimicrobials to combat pneumococcal infection. Our goal was to investigate the usefulness of penicillin conjugated gold nanoparticles (AuNP-Pen) in inhibiting the growth of planktonic *S. pneumoniae*. Synthesized AuNP and AuNP-Pen measured approximately 5-10nm spheres. Conjugation of penicillin was verified by a shift in the maximum absorbance spectra from 520nm (AuNP) to 525nm (AuNP-Pen). Pneumococcal strains that were sensitive and resistant to penicillin should reduce viability in the presence of the AuNP-Pen when compared to AuNP. The conjugate (AuNP-Pen) decreased the antibiotic effect when compared to free penicillin. The reduction ranged from 29-99% depending on the strain tested. These findings indicated that AuNPs and AuNP-conjugates have the potential to be effect antimicrobials for S. pneumoniae isolates of varying antiobiotic susceptibility profiles. Future studies include examine increasing concentrations of AuNP-Pen conjugates to identify a minimum inhibitory dose and also examine the genetic response of *S. pneumoniae* to antimicrobial nanoparticles, specifically AuNP and AuNP-Pen. *This work was supported by NSF-CREST (HRD-0734232) at Alabama State University, Montgomery, AL*.

GP-50. Hairy-Nanoparticles: General Brush Architecture

Vernecia Person

Dept. of Chemistry, Clark Atlanta University

This project involves the synthesis and characterization of Hairy-Nanoparticle systems. Synthesis of the polymer chains is accomplished via Atom Transfer Radical Polymerization. The union of the inorganic particle (silica particle) is accomplished via Click Reaction. The materials obtained will be experimentally characterized to determine their properties (Tg, fragility, enthalpic relaxation time, etc) as a function of molecular weight distribution, grafting density, and particle size. The simulation of these nano-composite models will be conducted to evaluate the ability of computational modeling to predict fragility as a function of structure. The Hairy-Nanoparticle systems are simulated using a method called MARTINI-Coarse-Graining to evaluate structural and dynamical properties of the brush, with special focus on the trajectories of the chain ends.

GP-51. The Effects of Potassium Hydroxide on the Thermal Properties of Surface Treated Woven Flax Fiber

Vertonica F. Powell-Rose, Alfred Tcherbi-Narteh, Mahesh Hosur, Shaik Jeelani

Material Science and Engineering, Tuskegee University

There is an evolving need for an environmentally friendly alternative material to replace synthetic fibers like glass and carbon in several fiber reinforced polymer composites applications. Natural fibers offer an excellent choice to replace glass and carbon fibers. Current research objectives are to find optimal uses for natural fibers and to address known challenges, such as a high degree of moisture absorption and poor thermal stability. Surface modification by means of chemical treatment was carried out to remove components of natural fibers such as lignin, pectin and hemicellulose that contribute to the known challenges of natural fibers. In this research study, two different chemical treatments were used on a commercially obtained woven flax fiber. Alkali chemical treatment was carried out at various times and concentrations. The treatment analysis was divided into two phases: 1) Alkali treatment using potassium hydroxide varying the concentration between 1 and 5 % for 30 minutes and 1 hour then 1, 3, and 5 % for 1, 2, and 4 hours, and 2) Analyze effects of the surface modification on the thermal properties and determine the best combination. Thermogravimetric analysis (TGA) data in the treatment for 30 minutes and 1 hour show very little change in the peak degradation temperature, when compared to the neat. Samples treated for 1, 2 and 4 hours showed an increase of 20° C or 6% in the peak decomposition temperature compared to the neat. There was an 18.17% reduction in the amount of residue compared the neat samples at 18.17%. These results indicate that the treatment causes the amount of moisture to reduce and removal of the lignin from the fiber structure which leaves less char. Scanning Electron Microscope (SEM) was used to study specific treatment time and concentration where the fibers began to dissolve the outer surface of the cell walls. From the SEM results, each treatment increases the roughness of the fiber surface which will lead to better interfacial adhesion between the fiber and the matrix.

GP-52. Diamond Nanoparticles Modified for Targeted Treatment of Prostate Cancer

[1]**Amanee D. Salaam**, [2]Aliza Poonawalla, [3]Roberus McIntosh, [3]Derrick Dean

[1] Department of Biomedical Engineering,
[2] Department of Biology, [3] Department of Materials Engineering, University of Alabama at Birmingham

Prostate cancer occurs more frequently than any other cancer type in the United States. Chemotherapy is considered one of the gold standards for treating metastatic disease. However, a major concern with chemotherapy is toxicity due to the lack of specificity. Consequently, research is focused on developing targeted cancer therapies as they may be more effective and less harmful to normal cells. In this research, nanodiamond (ND) particles are utilized as drug delivery vehicles mainly because of their rich surface chemistry and ability to act as transmembrane drug carriers. The drug delivery capabilities of ND have been optimized through understanding the physical adsorption and release characteristics of two drugs (doxorubicin hydrochloride and resveratrol). The drug loading capacity of ND has been established, and drug loadings achieved in this work are much higher than those reported in the literature. In addition, desorption or release of the drug from ND is easily controlled through altering pH. To facilitate specificity (i.e., tumor targeting), the ND nanoparticles have been further functionalized with a targeting peptide (DGEA) which interacts with integrins over-expressed on bone metastatic prostate cancer cells. Future work will focus on evaluating the *in vitro* feasibility of using ND as the central component for a drug delivery system with tumor targeting ability.

GP-53. Crossover between Triangular and Hexagonal Structure for Nitrogen-Carbon Cages

Carrie Sanders and Douglas Strout
Department of Physical Sciences, Alabama State University

Nitrogen cage N24 is known to energetically prefer an elongated structure with triangles whereas carbon cage C24 prefers the well-known fullerene-like structure with only pentagons and hexagons. The two types of three-coordinate cages differ because sp2-hybridized carbon prefers the near-planar geometry afforded by a spheroid, but sp3-hybridized nitrogen prefers nonplanarity and the tight curvature of a cylinder. A previous study on cages of N22C2 showed that the incorporation of two carbon atoms narrows the energy gap between cylindrical and spherical structures. In the current study, additional C2 units are incorporated into nitrogen cages to determine how many carbon atoms are required to make the fullerene-like hexagonal form preferred over other structures. Theoretical calculation with various methods are used to determine the energetics of various cage isomers.

GP-54. Fabrication and Functionalization of Tissue Engineering Polymer Systems Using Polymer Pen Nanolithography

[1]**Carrie Schindler**, [2]Brandon L. Williams, [2]Harsh N. Patel, [1]Vinoy Thomas, [1]Derrick R. Dean
[1] Dept. of Materials Science and Engineering,,
[2] Dept. of Biomedical Engineering, University of Alabama at Birmingham

As more technology shifts from the microscale to the nanoscale, the demand for new fabrication and characterization methods to investigate material properties on the nanoscale significanly increases. Dip-pen nanolithography (DPN) is an innovative printing technique with the precision to deposit a multitude of inks with nanoscale dimensions on a variety of substrates. This bottom-up approach of high-throughput printing has enabled the study of nanomaterials spanning the gamut of disciplines from nanoelectronics to single-cell interactions to drug delivery. However, the scalability and reproducibility of the DPN platform has yet to reach full potential in terms of large-scale material production. Specifically, the DPN platform can address some of the challenges that hinder the integration of tissue engineering polymer systems into industrial production. This study aims to develop electrospun polymer blends of polyglyconate (MaxonÂ®) and polycaprolactone (PCL) with tunable mechanical properties for tissue engineering of articular cartilage. In addition, this study focuses on the functionalization of the polymer scaffolds with bioactive inks via a modified DPN technique, polymer pen lithography (PPL).

GP-55. Characterization of Functional Polyaniline to form Metal-Ligand Complexes for Sensors

Tiana Shaw, James Reed, Michael Williams
Dept. of Chemistry, Clark Atlanta University

Copper I ligands can be used to detect specific specific biomolecules from its change in conductivity. Polyaniline has been shown to be an excellent polymer for sensor capabilities. In sensor applications, nanostructured polyaniline has greater sensitivity and faster time response relative to its conventional bulk counterpart. This is due to higher effective surface area and shorter penetration depth for target molecules. The conductivity of polyaniline can be changed/controlled through the reaction of redox reactive materials that can be complexed to create metal-ligand composite materials. The change in ratio of the imine to amine groups in the polyaniline should indicate the binding and reduction or oxidation of the polymer when mixed with a metal. In our study, copper (II) nitrate was bound to polyaniline. Copper and polyaniline ndergoes an oxidation-reduction reaction, which can reduce the copper II to copper I depending on themole ratio of the complex. Our study investigates the change in the oxidation state and proposed mechanism of the complex by varying the mole ratio of the reactants. The various metal-salt complexes were characterized using UV- Visible Spectroscopy, IR Spectroscopy, and Scanning Electron Microscopy.

GP-56. Bio-Based Interpenetrated Polymer Networks

Bernal Sibaja, Taylor Trippe, Ricardo Ballestero and Maria Auad
Polymer and Fiber Engineering, Auburn University

Interpenetrating polymer networks (IPNs), a kind of polymer system held together by permanent entanglements between two or more distinctly cross-linked polymers, have created increasing interest due to their excellent thermal stability and outstanding mechanical properties brought about by the synergistic effect induced during the interlocking of the polymer chains. Most of the polymer couples used to prepare IPNs are derived from petroleum. Due to the depletion of oil resources and the increasing social emphasis on issues concerning the environmental waste disposal, researchers have sought different ways to prepare these systems. The use of renewable resources to produce a remarkable variety of chemicals that can be turned into macromolecules represents an extraordinary strategy to synthesize polymeric materials. One of our research targets was focused on the IPN`s consisting of both polyurethane (PU) and polymethacrylate (PM) (representatives of two typical types of networks formed through step growth and chaingrowth

mechanisms respectively). In addition, our work has now been extended to the development of IPNs with high performance prepared from alternatives resources; which can prove to be valuable substitutes for existing materials in various applications. Thus, by employing triglyceride macromonomers as well as isoprene units obtained from essential oils as raw materials; and exploring their potential chemical modifications, the main purpose of this project is to cover the major aspects related to the chemical synthesis, physical-chemical characterization and study of the properties of bio-based IPN.

GP-57. Surface Plasmon Enhanced Light Trapping in Subwavelength Silicon Nano-Gratings

Xueli Tian and Junpeng Guo
Dept of Electrical and Computer Engineering, University of Alabama in Huntsville

We investigate and have demonstrated a dielectric nano-grating structure for completely trapping light in the visible and near-IR regimes. Both the TM and TE polarized incidence are investigated for achieving near perfect light trapping in the subwavelength nano-grating structure. The period, width and thickness of the dielectric nano-gratings are investigated as to their roles for light trapping. The silicon nano-gratings absorb more than 97% of the normal incident light at the peak wavelength. The perfect light trapping makes the nanostructure device potentially useful for biochemical sensor applications.

GP-58. The Investigation of Glassy Carbon and Carbon Nanofiber (CNF) Electrodes for the Detection of Glucose

Julaunica Tigner and Jessica Koehne
Center for Nanotechnology, Tuskegee University

Both glassy carbon and carbon nanofiber electrodes are proposed for the detection of glucose. Glassy carbon is a standard electrode material for biosensing due to its low electric resistance, wide potential window and good biocompatibility. Carbon nanofibers have the added advantage of being straightforward to integrate on a silicon-based device. The carbon nanofibers are vertically aligned and have a range of diameters from 25 to 100 nanometers and heights ranging from hundreds of nanometers to several microns. The objectives of this investigation are the following: (1) perform electrochemical characterization on both the glassy carbon and the carbon nanofibers sensors, and (2) create a glucose sensor comparable with commercially available glucose sensors on the market today. The results are forthcoming.

GP-59. Bio-Waste Derived Calcium Silicate Nanoparticles for Tissue Regeneration and Structural Reinforcement Applications

Boniface J. Tiimob, Vijaya K. Rangari, Tsemesgen Samuel. Shaik Jeelani.
Materials Science and Engineering, Tuskegee University

In this study, biobased calcium silicate (Î²-wollastonite) nanoparticles were synthesized from calcium carbonate (waste egg shell) and anhydrous amorphous silica in a solid state reaction through ball milling and ultrasonic techniques. It was then characterized using TEM and XRD. This revealed a polycrystalline calcium silicate particles with sizes ranging from 20-100nm. Flexure test and thermomechanical analysis (TMA) on fabricated composite specimens in which a biobased epoxy resin was reinforced with 1-4 wt. % of the calcium silicate showed improvements in strength, modulus, toughness and reduction in Coefficient of thermal expansion (CTE) respectively. Also, cell cytotoxicity studies using human osteoblast cell line CRL 11372 with the calcium silicate nanoparticles showed biocompatibility and promotion of cell proliferation in Simulated Body Fluid (SBF). Hence, this work demonstrated that calcium silicate synthesized from waste egg shells and non-reinforcing silica precursors has the potential to enhance the structural integrity of materials and to regenerate damaged tissues.

GP-60. Novel Peptide Functionalized Gold Nanoparticles as *In Vivo* Delivery Vehicle

[1]**Pooja M. Tiwari**, [1]Erdal Eroglu, [1]Komal Vig, [2]Michael E. Miller, [1]Vida A. Dennis, [1]Shree R. Singh
[1]Center for NanoBiotechnology Research, Alabama State University
[2] Auburn University, Auburn

Gold nanoparticles (GNPs) have found their significant applications in biomedical fields spanning cancer diagnosis and therapy, targeted delivery and molecular detection due to simple requisites for synthesis and functionalization, lower cytotoxicity, biocompatibility and conjugation to macromolecules. The efficiency of internalization, bio-availability and biodistribution of these nanoparticles vastly depends on the type of functionalization, which in turn affects the applicability of the GNPs. To achieve these goals, various cell penetrating peptides (CPPs) have been developed, facilitating cellular uptake of nanoparticles. CPPs are attached to nanoparticles either through covalent or non-covalent interactions and translocate with the cargo into cells mostly through endocytosis. For the first time, we have designed a carrier peptide and functionalized GNPs. The nanoparticles were characterized using UV-Vis spectroscopy, TEM and Zetasizer. The cytotoxicity of these GNPs, peptide and functionalized GNPs (fGNPs) were assessed on HEp-2, HeLa, Vero and Cos-7 cell lines. The intracellular uptake of these fGNPs was investigated using flow cytometry, fluorescence microscopy and ICP-MS analyses. Further, the ultrathin sections of the nanoparticles treated cell lines were analyzed using TEM for intracellular tracking. We also investigated the efficacy of these fGNPs, on female BALB/c mice injected intravenously. After 3 days, mice were sacrificed; blood and organs were collected, fixed and processed for ICP-OES analysis, TEM and histopathology. From our results, we clearly found that the fGNPs were internalized more efficiently up to 20µg/ml and ~30µg/ml in liver and spleen respectively, without any significant pathological changes in mice tissues as compared to gold nanoparticles.

GP-61. Thermo-Mechanical Analysis of Bio-Based Polyester Resin Infused with a Synthesized Tung Oil Additive for Styrene Replacement

Eldon D. Triggs II
Materials Science and Engineering, Tuskegee University

With the increase in population coupled with the decreasing available landfill space, the need to find biodegradable composites is ever increasing. Combine this with the increase in greenhouse gas emissions from the manufacture, use, and disposal of synthetic composites and the need is even greater.

The desire to enhance current synthetic polyester resins by infusing with various plant oil polyol blends is driven by two motives; reduction or removal of styrene from the system to prevent possible carcinogenic and neurological effects and the desire to move from synthetic petrochemical based resins to a plant oil substitute to allow for sustainable development. This research uses a commercial bio-based polyester resin made from 22% bio-based 1,3 propanediol and further increases the bio-based content by combining with a tung oil and 1,3 propanediol mixture (SUSTO) in increasing amounts. Current results demonstrate that the thermo-mechanical characteristics including dynamic mechanical analysis (DMA), thermo-gravimetric analysis (TGA), and differential scanning calorimetry (DSC) are maintained with increasing amounts of SUSTO up to 6 parts per hundred resin. This work is the baseline of research into the properties of the SUSTO mixture and for further development into a 50-75% bio-based polyester resin with minimal amounts of maleic anhydride. Total removal of styrene, maximum amount of tung oil content, and thermo-mechanical properties consistent with those of fully synthetic polyester resins are the end goal of this work.

GP-62. Fabrication and Mechanical Characterization of Brazilian Clay/Biodegradable Epoxy Nanocomposites

M. Jamal Uddin, Francisco R. V. Diaz, Esperidiana A. B. Moura, S. Jeelani and V. Rangari

Materials Science and Engineering, Tuskegee University

The addition of a small amount (< 5 wt%) of fillers such clay or nanoparticle fillers can show significant improvement in mechanical, thermal and barrier properties, flammability resistance and electrical/electronic properties of the final polymer nanocomposite. In this work, we present the preparation and characterization of a nanocomposite based on bio-based epoxy resin (containing 37% bio-based carbon content) and Brazilian smectitic bentonite chocolate clay (clay). The as-received clay was modified by the addition of a quaternary salt and sodium carbonate and further infused into the epoxy polymer. Thermal and flexural properties were investigated for neat epoxy and 1wt%, 2wt%, 3wt% clay infused epoxy resin. The preliminary results show that the flexural modulus increased consistently with increasing weight percentage of clay. The flexural strength was increased ~12% for 2wt% clay loading and further higher loading did not show any significant improvement. The X-ray diffraction and microscopic analysis confirmed the exfoliated structure and uniform dispersion of 2wt% loading of clay in the entire volume of the polymer. The further studies are in progress in improve the strength by increasing the loading of these clay particles.

GP-63. Synthesis and Characterization of Modified Resole Phenolic Resins

Dereca Watkins, Mahesh Hosur, Melissa Reeves, Mary Moore, Shaik Jeelani

Materials Science and Engineering, Tuskegee University

Major disadvantages with the synthesis of resole phenolic resins are the toxic effects of the starting materials, phenol or formaldehyde, on the human body. The goals of the current research are geared towards finding alternate materials to serve as replacements for the phenol precursor of a resole phenolic resin and to produce 2 wt% filler composites based on the unmodified and best modified phenolic resins. The unmodified resole phenolic resin was synthesized using a molar ratio of phenol to paraformaldehyde of 1:5 in the presence of a basic catalyst reacted with paraformaldehyde at 75 °C for one hour and cured using a multi-temperature schedule. The modified phenolic resins were created similarly with the exception of using full replacements of pyridoxine or 3-hydroxypyridine as starting phenolic precursors.Carbon-13 nuclear magnetic resonance observed the structural difference between the resins. Pyridoxine formaldehyde resin never cured whereas the 3-hydroxypyridine formaldehyde resin did cure. No direct correlation between calculated and synthesis of the modified phenolic-type systems were found. The resulting materials were subjected to thermogravimetric analysis (TGA) thermal degradation. Solid state thermal decomposition kinetic parameters were determined from the acquired TGA results using the Madhusudanan-Krishnan-Ninan method. The silicon-based nanofiller composites were seen to affect the thermal properties. The 3-hydroxypyridine formaldehyde with nanoclay increased the flame retardency property and had a greater char yield overall proving that the sample has better fire properties as compared to other composites. *This material is based on work supported by the National Science Foundation under Grant No. NSF EPS- 1158862 and IGERT.*

GP-64. Inorganic Nanocylinder Nemetic and Smectic Liquid Crystals: Phase Behavior and Self-Assembly

Teng Xu and Virginia A. Davis

Department of Chemical Engineering, Auburn University

Inorganic nanocylinders are very interesting due to its anisotropic properties. However, there is a need to establish processing routes for large-scale manufacturing of nanocylinder thin films/coatings with controlled morphology. This requires a fundamental understanding of dispersion phase behavior and self-assembly of inorganic nanocylinder dispersions. We report lyotropic liquid crystal phase formation for two systems: low aspect ratio silica nanorods dispersed in mixtures of dimethyl sulfoxide and water ($DMSO/H_2O$), and high aspect ratio silver nanowires and spherical nanoparticle aggregates dispersed in ethylene glycol and water. The phase behavior of both systems was evaluated using microscopy and rheology. The phase behavior for silica nanorod system was a function of solvent quality and nanocylinder volume fraction. For the silver nanowire and nanosphere aggregate system phase behavior also depended on the nanowire:nanosphere ratio. The rheology of these two systems was consistent with expectations for macromolecular lyotropic liquid crystals. Several methods for assembling the dispersions into solid films were explored. Coatings assembled by drying low aspect ratio silica nanorod biphasic dispersions in the absence of shear showed the characteristic “coffee ring” structure; the rods were circumferentially aligned along the outer edge. When applying the same method to silver nanowire and nanosphere aggregate system, no “coffee ring” structure was observed. However, applying shear force to both systems` biphasic dispersion before drying increased alignment along the shear direction.

Faculty/Post-doc Presentations

OP-01. Preparation, Characterization and Biological Evaluation of Multifunctional Nanoscale Drug Delivery System for Prostate Cancer Therapy and Imaging

Mohamed O. Abdalla, Jessie Jaynes, Clayton Yates, Timothy Turner

Dept. of Chemistry and Dept. of Biology, Tuskegee University

Prostate cancer (CaP) is one of leading causes of cancer deaths among men. Within the United States population, African-American men are 65 percent more likely to be diagnosed with CaP than Hispanic Americans or Caucasian Americans. Current chemotherapeutic agents for CaP are disadvantageous to a patient`s system such as: toxicity to fast dividing normal tissues, drugs with low therapeutic index, drug resistance in tumor cells, and inability to control dosage based on prognosis. Thus, there is an urgent need to develop novel drug delivery systems to improve the chemotherapy option for CaP patients. The goal of this research was to develop novel moleculary guided nanoscale drug delivery systems with dual functionality for treatment and imaging of CaP. We developed and optimized a moleculary guided nanoscale drug delivery system which is also MRI (Fe_3O_4 core) and optically imageable (NIR-dye Cy5.5). This targeted system takes advantage of over-expression of the urokinase plasminogen activator receptor (uPAR), the receptor in CaP cells, compared to normal epithelia. Specifically, we employed the human-type 135 amino-acid amino-terminal fragment (hATF) of the urokinase plasminogen activator (uPA), which is a high-affinity natural ligand for uPAR. Prussian blue staining elucidated that these uPAR-targeted NPs can bind to the receptors and are internalized by PC-3 cells. CONCLUSION:The efficient internalization of these uPAR-targeted NPs in PC-3 cells was translated to 6-fold stronger inhibitory effect compared to the free drug.

OP-02. Targeted Liposomal Drug Delivery via Secretory Phospholipase A_2 and its Receptor

[1]**R.D. Arnold**, [2]J.N. Mock, [2]G. Zhu, [2]N. Quach, [2]N.E. Scholpa, [1]A. Burcham, [1]B. Nie, B.S. [2]Cummings

[1]Pharmacal Sciences, Harrison School of Pharmacy, University of Auburn

[2]Pharmaceutical and Biomedical Sciences, College of Pharmacy, University of Georgia

Secretory phospholipase A_2 ($sPLA_2$) cleave phospholipids at the *sn-2* bond and are overexpressed in many cancers, including prostate. Once secreted, $sPLA_2$ can be sequestered back inside cells *via* the PLA_2 Receptor (PLA2R). This study investigated the roles of $sPLA_2$ and PLA2R on release, uptake and antitumor activity of $sPLA_2$ responsive liposomes (SPRL). $sPLA_2$ and PLA2R expression were determined in LNCaP, PC-3 and DU-145 prostate cancer cell lines using RT-PCR and immunoblot analysis. PLA2R protein expression was greatest in PC-3 and DU-145 cells compared to LNCaP and normal prostate cells. Several $sPLA_2$ isoforms, including Ib, IIa, V and X, were also expressed in these cells. PLA2R knock down reduced the activity of SPRL formulations, but had no effect on free or conventional liposomes. Interestingly, SPRL uptake was greatest in PC-3 cells, corresponding with PLA2R expression. Fluorescent microscopy demonstrated co-localization of doxorubicin and SPRL formulations in all cell lines. These data show the novel finding that PLA2R is differentially expressed in prostate cancer cells lines and that PLA2R expression correlates to SPRL uptake. These data indicate that $sPLA_2$-mediated lipid degradation and drug release from liposomes is not solely responsible for the observed antitumor effects. Further, evaluation of SPRLs in a mouse model of human prostate cancer (PC-3) demonstrated enhanced antitumor activity compared to clinically utilized doxorubicin liposomes. These data suggest that $sPLA_2$ and PLA2R mediate the uptake and toxicity of lipid-based nanoparticles and may prove a viable therapeutic target for altering the delivery and efficacy of nano-based drugs and/or imaging agents.

OP-03. Development of miRNA-loaded Polymeric Nanoformulation for Pancreatic Cancer Therapy

Sumit Arora, Suresh K. Swaminathan, Sanjeev K. Srivastava, Seema Singh, Jayanth Panyam, Ajay P. Singh

Mitchell Cancer Institute, University of South Alabama

MicroRNAs (miRs) are small (18-22 nucleotide long) non-coding RNAs that play important role in biological processes through post-transcriptional regulation of gene expression. Their aberrant expression and functional significance are reported in several human malignancies, including pancreatic cancer (PC). Recently, we identified miR-150 as a novel, tumor suppressor microRNA in PC. Furthermore, expression of miR-150 was downregulated in majority of tumor cases, suggesting that its restoration could serve as an effective approach for pancreatic cancer therapy. In the present study, we have developed a nanoparticle-based miR-150 delivery system and tested its therapeutic efficacy by in vitro assays. Using double emulsion solvent evaporation method, we developed a poly (D, L-lactide-co-glycolide) (PLGA)-based nanoformulation (NF) of miR-150 (miR-150-NF). Polyethyleneimine (a cationic polymer) was incorporated in PLGA matrix to increase the encapsulation of miR-150. Physical characterization of miR-150-NF demonstrated that miR-150-loaded nanoparticles were spherical in shape, had high encapsulation efficiency (>75%), were stable at room temperature and exhibited sustained release profile. miR-150-NF efficiently delivered miR-150 mimics to PC cells and led to the downregulation of its target gene (MUC4) expression. Downregulation of MUC4 correlated with a concomitant decrease in the expression of its interacting partner, HER2, and repression of its downstream signaling. Furthermore, treatment of PC cells with miR-NF suppressed their growth, clonogenicity, motility and invasion. Together, these findings suggest that PLGA-based nanovector platform could be a potential candidate for systemic delivery of miR-150 to the pancreatic tumor cells and can be a step forward in miRNA-based cancer therapeutics.

OP-04. Bacterial Quorum Sensing Molecules: A Possible Target for Nanoparticle-based Antibacterials

Atul A. Chaudhari and Shreekumar R. Pillai

Center for Nanobiotechnology Research, Alabama State University

Bacterial pathogens rely on a membrane bound sensor kinases to coordinate their virulent gene expression in a process called as quorum sensing. QseC sensor kinase is an important component of a two-component regulatory system in bacteria, wherein it

represents as a signal receiving molecule and controls the activity of its response regulator. Given the role QseC play in bacterial virulence, targeting its activity holds promise in developing anti-bacterial agents. Herein, we present that in vitro host innate immunity to a recombinant QseC molecule regulates virulence gene expression of a virulent strain of E. coli. Host macrophages were stimulated with QseC and a pathogenic E.coli strain was exposed to the culture medium of the stimulated macrophages. Parameters such as growth curve analysis and expression of a few virulence genes including aufA, fliC, fimH, fyuA, iucC, iutA, msbB and vat were investigated. Growth curve analysis indicated that growth rate of pathogenic E.coli in LB broth containing the culture medium of stimulated macrophages was impeded upon entering the exponential phase and was significantly lowered (47%) compared to non-treated group. The expression of virulence genes of the pathogenic E. coli strain was also completely suppressed (100%) in the treated group. Present data thus indicate that innate immunity against the QseC molecule can modulate bacterial virulence gene expression. With the recent advancement of rapidly growing peptide-conjugated nanotechnology approach, identifying the peptides that target sensor kinase molecules and their conjugation with nanoparticles may be useful in developing new antimicrobial strategies.

OP-05. PLA-PEG Nanoparticles Delivery of Chlamydia Trachomatis Recombinant MOMP-278 Triggers Enhanced Antibody Immune Responses in Mice and Inhibits Infection of Macrophages in vitro

Saurabh Dixit, Shree R. Singh and Vida A. Dennis
Center for NanoBiotechnology Research, Alabama State University

Chlamydia trachomatis is the most frequently reported bacterial sexually transmitted infection worldwide, and is of public health concerns because it causes considerable morbidity and socioeconomic burdens. There is no approved vaccine against C. trachomatis, probably either due to ineffective delivery systems or formulations that do not augment immune responses to achieve long-term protective immunity. PLA-PEG [poly (lactic acid)-poly (ethylene glycol)] is a biodegradable nanoparticle with low toxicity, high encapsulation efficiency, biocompatibility and controlled release properties that is underused for vaccine delivery. Here, we encapsulated M278, a Chlamydia trachomatis peptide, in PLA-PEG (PLA-PEG-M278) by a double emulsion method and achieved ~ 73 nm size, -16 mV zeta potential, smooth surface and encapsulation efficiency of 60%. Studies in vitro revealed that PLA-PEG-M278 provided a sustained slow release of encapsulated-M278 and was nontoxic to macrophages. Four groups of BALB/c mice (PLA-PEG-PBS, PLA-PEG-M278, PBS and M278), received three subcutaneous immunizations at two-week intervals to evaluate the immune-potentiating capacity of PLA-PEG. Two weeks after the last immunization serum was collected for antibody isotyping using ELISA. PLA-PEG-M278 immunized mice produced higher M278-specific antibodies as compared to those produced in mice immunized with only M278 in the order of IgG1>IgG2b>IgG2a. PLA-PEG-M278 immune serum inhibited Chlamydia infectivity of macrophages and the transcriptional expression of MOMP, its cognate TLR2, and the CD80 co-stimulatory molecule. Our findings disclose that PLA-PEG is attractive for vaccine delivery because it immune-potentiates, and provides sustained slow release of antigens to bolster immune responses.

OP-06. In Vitro Delivery of RF-491 Peptide via Newly Developed pHEMA+Chitosan Nanospheres

Erdal Eroglu, Pooja M. Tiwari, Vida A. Dennis, Shree R. Singh
Center for NanoBiotechnology Research, Alabama State University

Low bioavailability of either protein or DNA vaccines is the most common impediment for efficient use of these molecules in low concentrations because of the host barriers. Alternatively, nontoxic, biocompatible, stable and efficient delivery systems are required to increase the efficacy of vaccines in living systems. Cellular uptake of vaccine molecules into the cytosolic compartment is essential for efficient applications. RF-491 is designed from the respiratory syncytial virus (RSV) fusion protein (F) and is 20 amino acids in length. Recently, we have shown enhanced intracytoplasmic delivery of DNA molecules using composition of pHEMA+chitosan polymers in nano size. The aim of this study was to encapsulate RF-491 peptide in pHEMA+chitosan nanospheres (PCNSs) and delivery of the payload into the cytoplasm. For that reason, different concentrations of FITC tagged RF-491 peptide was loaded into PCNSs and the encapsulation was characterized using UV-visible spectroscopy, fourier transformed infrared (FTIR) spectroscopy, zeta potential, immunofluorescence microscopy and transmission electron microscopy (TEM). The various concentrations of RF-491 peptide in 100 µg/ml, 250 µg/ml and 500 µg/ml were encapsulated into PCNSs and the synthesized complex was named as PCP. The loading of the peptide in PCNSs was demonstrated with UV-visible and FTIR spectroscopy. The morphology of PCP was imaged using TEM. The attachment and uptake of the PCP into Cos-7 cells were shown after 4 hours until day-4 following the transfection using immunofluorescence microscopy and flow cytometry. We devised, for the first time, a pHEMA+chitosan nanospheres encapsulated with RF-491 peptide.

OP-07. Fabrication of Single Walled Carbon Adsorbent Pads and the Photo-Thermal Desorption of Toluene from these Pads

[1]**E. Floyd**, [2]S. Connell, [2]J. Oh, [2]CT Lungu
Center for Health Sciences, [1]University of Oklahoma.
School of Public Health, Environmental Health Sciences,
[2]University of Alabama at Birmingham

Activated Carbon (AC) is widely used to collect volatile organic compounds (VOCs) in air samplers. Laboratory analysis is performed by chemical or thermal desorption. Both these methods present limitations with respect to either sensitivity (chemical) or cost (thermal) and are time consuming. A less expansive technique that achieves partial desorption and improves sensitivity over chemical desorption would be preferable. Single Walled Carbon Nanotubes (SWNT) have similar VOC adsorption properties as AC, camera flash has been used to ignite SWNT; therefore, light flash could be used for desorption. We prepared SWNT-felt pads, loaded them with toluene vapors and used light flash to achieve partial desorption. Light flash of different energies is applied to AC and SWNT samples. Samples were loaded with toluene at four masses and flashed once per minute. Light is absorbed and converted into

heat causing desorption. A photo ionization detector was used to determine desorbed toluene mass. SWNT-felt desorption was nearly constant across successive flashes whereas SWNT-powder and AC-powder exhibit exponential decay after first flash. At 435ug toluene and 4.7J flash, first flash and 10-flash desorption was: SWNT-felt 0.86%, 7.71%, SWNT-powder 0.57% and 2.92%, AC-powder 0.34% and 1.37%. At 10ug toluene and 4.7J flash, desorption was: SWNT-felt 0.74%, 5.22%, SWNT-powder 1.14% and 5.23%, AC-powder 1.47% and 4.19%. At lower loading and lower energy, desorption was below detection limit. Single flash desorption can deliver more sample to an analytical instrument than chemical extraction. SWTN-felt desorption is additive whereas SWNT-powder and AC-powder are exponentially decaying.

OP-08. Emergence of Peripheral Disease after Brain-directed Gene Therapy in a Feline Model of Sandhoff Disease

Heather Gray-Edwards, Allison Bradbury, Diane Wilson, Brandon Brunson, Ashley Randle, Victoria McCurdy , Aime Johnson, Nancy Cox, Douglas Martin
Scott-Ritchey Research Center Auburn University

Feline GM2 gangliosidosis is an animal model of Sandhoff disease (SD) that is currently untreatable in humans and fatal by 5 years of age. It is caused by a mutation within the beta subunit of hexosaminidase (Hex), a lysosomal enzyme that cleaves neutral and charged substrates throughout the brain and body. Intracranial adeno-associated viral (AAV) gene replacement of hexosaminidase alpha and beta subunits results in a >four-fold increase in lifespan of Sandhoff cats, with marked attenuation of neurologic signs. This dramatic increase in life span due to successful treatment of the brain permits otherwise subclinical peripheral disease to emerge. Monocistronic AAVrh8 vectors expressing feline Hex Î± and Î² subunits (1:1 ratio; 4.4Ã—1012 g.c. total) were injected bilaterally into the thalamus and deep cerebellar nuclei of Sandhoff cats. Here we describe peripheral manifestations of feline Sandhoff disease after intracranial AAV gene therapy. Skeletal abnormalities, gastrointestinal and cardiovascular dysfunction are a significant source of morbidity in AAV-treated SD cats. Therefore characterization of peripheral disease in the feline model is important to determine areas to be targeted in future therapeutic strategies and as to inform potential outcomes in future human clinical trials.

OP-09. 3T MRI and MR Spectroscopy of a Feline Model of GM1 Gangliosidosis after AAV-Mediated Gene Therapy

Heather L. Gray-Edwards, Nouha Salibi, Diane Wilson, Ashley Randle, Ronald J. Beyers, Thomas S. Denney, Ravi Seethamraju, Shumin Wang, Xiaotong Sun, Allison M. Bradbury, Victoria J McCurdy, Aime K. Johnson, Nancy Cox,Douglas R
Scott Ritchey Research Center Auburn University

Human GM1 gangliosidosis results from a deficiency of lysosomal Î²-galactosidase (Î²gal), which causes storage of GM1 ganglioside, progressive neurodegeneration and early death, often by age five. MRI and MRS were used to non-invasively evaluate the effect of gene therapy in a feline GM1 model, prior to initiating human clinical trials. AAV2/rh8 vectors expressing a feline Î²gal cDNA (3.1-12.0e12 g.c. total) were injected bilaterally into the thalamus and deep cerebellar nuclei (DCN) of 2-month old GM1 cats (disease onset ~3.5 months). MRI and MRS data were acquired on a 3 Tesla MAGNETOM Verio scanner (Siemens Healthcare, Erlangen, Germany) using an 8 channel phased array wrist coil (Invivo corp Gainesville, FL, USA). Single voxel spectroscopy (SVS) was then acquired using PRESS (Point RESolved Spectroscopy) with CHESS (CHESS (CHEmical Shift Selective) water suppression, TE/TR = 30/2000ms and 32 averages. In all animals a (4x5x13) mm^3 voxel was placed in the parietal cortex that was well defined on the high resolution anatomical images. All metabolite peak integrals were normalized to creatine (Cr). MRI shows preservation of white and grey matter structures after gene therapy that has, in ongoing studies, extended the life of GM1 cats >3 fold with negligible neurologic signs. Data collected in the untreated GM1 cat are consistent with the published literature in humans. Data in the 32 month AAV-treated cat are intriguing and future studies are planned for determination of individual metabolite variations using an external reference solution with the phantom replacement quantification technique.

OP-10. Reduced Bacterial Attachment on Super-hydrophobic Paper Samples

[1]**Sapna Jain**, [2]Lester Li, [2]Dennis Hess, [1]Cleon Barnett, [1]Marcus Davis, [3]Charlemagne A Akpovo, [3]Jorge Martinez Jr., [3]Lewis E Johnson, [4]S. Singh, [4]S. Pillai
[1]Dept of Physical Sciences, Alabama State University
[2]School of Chemical and Biomolecular engineering, Georgia Institute of technology
[3]Dept. of Physics, Florida A and M University
[1]Center for Nanobiotechnology Research, Alabama State University

Cellulose-based paper surfaces were modified by plasma etching and fluorocarbon polymerization that led to surface superhydrophobicity (water contact angle (CA) >160). Two types of modified papers, one with low hysteresis (LH) and the other with high hysteresis (HH) were then studied for their effect on bacterial attachment as compared to untreated paper. Reduction of bacterial count after dropping suspensions of Salmonella enterica serovar Typhimurium on HH and LH papers was observed. The average values of the six replicates of the colony forming units for the untreated, HH and LH were found to be 6.4*107, 1.4*107 and 0.5*107 respectively. A single laser pulse from a Nd:YAG laser operating at 532 nm was employed for elemental analysis using Laser induced break down spectroscopy (LIBS). The atomic emission is approximately 2-3 times higher from the LH paper as compared to HH paper. LIBS offer a relatively quick method of differentiation between the types of papers. The modified paper may have potential applications in a vast array of products including microwavable food packages and self-cleaning cartons.

OP-11. Molecular Evaluation of Stress Related Genes of Salmonella after Treatment with Silver Coated Carbon Nanotubes

[1]**Sapna Jain**, [2]Lewis Pannell, [2] Linday Schambeau, [3]Michael Miller, [4]Shree R. Singh, [4] Shreekumar Pillai
[1]Dept. of Physical Science, Alabama State University
[2] Mitchell Cancer Research Institute, University of South Alabama
[3] Auburn University,

[4]Center for NanoBiotechnology Research, Alabama State University

Silver coated carbon nanotubes (AgCNT) have been shown to inhibit emerging multi-drug resistant food-borne pathogens such as Salmonella enterica serovarTyphimurium. The application of these nanoparticles requires a clear understanding of their mechanism of action. The sequential morphologic, molecular and proteomic studies of Salmonella exposed to nanoparticles has helped elucidate the mechanism by which the nanoparticles inhibit the bacteria. The evaluation of the antibacterial activity of AgCNT and plain CNT against Salmonella enterica serovar Typhimurium using morphologic studies including scanning and transmission electron microscopy in sequential time line was done. Molecular evaluation of the genes associated with known stress responses and other specific functions in Salmonella such as rpoB, phoP, omp, elongation factor (EF) and the tetrathionate reductase gene locus (ttrRSBCA), key to bacterial survival have been studied by qPCR analysis using the Applied Biosystems 7300 thermocycler. Some of the genes like EF, phoP were up-regulated by the treatment with Ag-CNT, whereas genes like omp and rpoB were down-regulated. Proteomics data matrix analysis showed changes in transcription and protein modification. The ultrastructural images revealed remarkable morphologic alteration of bacteria treated with AgCNT. Most of the bacteria appeared to be lysed or fragmented around 4-8 hours. Predominant early changes included misshapen bacterial cells with lysed cell walls and cytoplasmic membranes separated from the cell wall. Surviving bacteria or those unaffected by the AgCNT recovered after overnight incubation. Quantitative real-time PCR analysis also showed that there was a dose- dependent reduction in the Salmonella ttrRSBCA locus DNA concentration after exposure to AgCNT.

OP-12. Expression of Respiratory Syncytial Virus Recombinant F Protein (residue 301-524) and Nanoparticle Mediated Protein Delivery System

Medhavi Medhavi, Erdal Eroglu, Swapnil Bawage, Vida A. Dennis, Shree R. Singh

Center for NanoBiotechnology Research, Alabama State University

Respiratory syncytial virus (RSV) is a negative sense RNA virus which causes severe respiratory tract illnesses, especially among children worldwide. Despite vaccine development efforts for the last few decades, there is no licensed vaccine available in the market. Enhanced mucosal immunity is required for the protection against RSV associated infections. RSV fusion (F) protein is one of the potential vaccine candidates due to the high immunogenicity and conserved sequence. Also, the RSV-F epitopes are known to induce protective humoral and cellular immune response. In this study, we have been developing a protein vaccine (RF301-524) consisting of residue 301-524 of the RSV-F protein and encapsulating the payload into the chitosan nanoparticle. For that reason, RF301-524 gene fragment was cloned in pET32 vector and transfected into Escherichia coli BL21 protein expression host. Purified RF301-524 protein was analyzed using SDS-PAGE and western blot. Medium molecular weight (MMW) chitosan was purified using alkaline deacetylation method and RF301-524 protein was loaded into the chitosan nanoparticles (CNP-RF301-524). To our knowledge, this is the first study wherein, the RF 301-524 protein was expressed and encapsulated into chitosan nanoparticles to facilitate the delivery to counter RSV.

OP-13. The Central Analytical Facility at The University of Alabama: A Shared User Facility for Nanoscale Characterization

David E. Nikles, Johnny Goodwin, Robert Holler, Richard Martins, Gregory B. Thompson

The Central Analytical Facility, The University of Alabama

The Central Analytical Facility (CAF) has a mission of service in support of the teaching, research and service missions of the University of Alabama. It is a shared user facility with a professor staff who trains users on the safe and productive use of its major instruments. The CAF has two scanning electron microscopes including a JEOL 7000 FEG source SEM equipped with EDX, WDS, EBSD, SE, BE and TE detectors, plus Nabity E-beam lithography. The FEI Tecnai F-20 FEG source transmission electron microscope is equipped with a CCD camera for STEM, HAADF detector, EDAX EDX and a NanoMEGAS for orientation mapping. The CAF has two dual been focus ion beam microscopes, including a thermionic source FEI Quanta 3D dual beam FIB and a TESCAN LYRA XMU Variable Pressure Scanning Electron Microscope and Focused Ion Beam. These find use in specimen preparation, particularly for TEM samples or samples for atom probe tomography. The CAF has a Cameca Local Electrode Atom Probe for atom probe tomography, which includes a pulsed laser for characterization of semiconducting or non-conducting samples. Users have hands on access to the instruments and can schedule time through our web page.

OP-14. SynVivo: A Physiological Microfluidic Platform for Cell Based Assays

B. Prabhakarpandian, Ashley Smith, Charles Garson, Ivy Mills, Kapil Pant

Dept of Biomedical Technology, CFD Research Corporation

Cell-cell interactions are critical components of many physiological and pathological conditions in the microvasculature. Similarly, particle-cell interactions play an important role in targeted delivery of therapeutics to the microcirculation as well as nanoparticle exposure and toxicity assessment. Static well plate assays and in vitro fluidic devices have been instrumental in our understanding of the biological phenomena. However, widely used parallel plate flow chambers suffer from several limitations for studying the physiological conditions in vivo. These include, (a) lack of critical morphological features (e.g., bifurcations, tortuosity), (b) inability to distinguish between healthy vs. diseased vasculature, (c) large consumable volumes and (d) inability to support co-cultures. To overcome these limitations, we have developed a patented microfluidic cell based platform: SynVivo which comprises of idealized and in vivo derived microvascular networks patterned onto a plastic, disposable substrate to mimic the morphological and physiological conditions observed in vivo. Cells (e.g., endothelial, tumor) can be readily grown in the device in mono culture or co-culture conditions, thereby enabling cell-drug particle studies in the most in vivo like environment. Sample results from studies on drug particle adhesion, drug transport, gene delivery, cell migration and

toxicity will be presented. Future applications and planned developments of the SynVivo platform will be highlighted.

OP-15. Silver-CNTs and Peptide 557 as Antimicrobials against *Streptococcus pyogenes*

Ruchir Rastogi, Shreekumar Pillai, Shree R. Singh, Komal Vig
Center for Nanobiotechnology Research, Alabama State University

Streptococcus pyogenes – a spherical, gram-positive bacterium – is the bacterial species responsible for streptococcal pharyngitis ("strep throat") and other mild to life-threatening diseases, such as impetigo and rheumatoid fever. While antibiotics against S. pyogenes are available, they frequently do not work, necessitating alternative methods to treat the disease. Moreover, the growing trend towards antibiotic resistance within bacterial populations dictates the need to find a novel treatment modality. In this study, we used silver-coated carbon nanotubes (CNTs) along with a proprietary peptide 557 from Therapeutic Peptides Inc. CNTs and peptide 557 was mixed in a one-to-one ratio to enhance the antimicrobial affectivity of the complex. The antimicrobial activity was determined through minimum inhibitory concentration assay (MIC), growth curves and standard plate counts. Our results showed that the mixture was two times more effective than silver-CNTs alone and four times more effective than peptide alone. Moreover, minimum bactericidal concentration (MBC) assays indicated that a mixture containing 200 µg/ml of silver-CNT and peptide each was bactericidal, whereas a mixture with a lower concentration was only bacteriostatic. Additionally, plate-count assays and growth curve assays corroborate our findings. Plate count assays confirm that a solution containing 25 µg/ml of each inhibits upto 99 % of bacterial growth. Based on our results, a silver-CNT and peptide mixture has the potential to function as a novel treatment modality against Streptococcus pyogenes. We plan to perform more research to determine the causation of the complex's antimicrobial activity through both SEM studies and gene expression analysis.

OP-16. PLGA-Chitosan Encapsulated IL-10, an Anti-Inflammatory for Chronic Inflammatory Disease

Praseetha Subbarayan, Abebayehu N. Yilma, Shree R. Singh, Vida A. Dennis
Center for NanoBiotechnology Research, Alabama State University

Interleukin-10 (IL-10), an anti-inflammatory cytokine, has been investigated as a therapeutic agent for autoimmune and inflammatory diseases. The short biological half-life of IL-10 limits its usage and requires large, and frequent, dosage administration. In this study we encapsulated IL-10 in nanomaterials to extend its biological half-life. IL-10 was encapsulated in Poly-(Lactic-co-Glycolic Acid) (PLGA)-chitosan nanoparticles by the double emulsion method, and subjected to physiochemical characterizations including Scanning Electron Microscope (SEM), and Differential Scanning Calorimetry (DSC). The biocompatibility of encapsulated IL-10 was analyzed using [3-(4, 5-dimethylthiazol-2-yl)-2, 5-diphenyltetrazolium bromide) (MTT)] assay; whereas its release profile and biological activity were evaluated using mouse J774 macrophages and BALB/c mice. The present study shows encapsulated-IL-10 small size (100-200 nm) and encapsulation efficiency of 96%, a steady *in vitro* release pattern for up to 29 days, and its safety to eukaryotic cells. Our data shows that encapsulation of IL-10 within nanomaterials extends its biological half-life; allows its slow release, while maintaining its native biological activity. Preliminary studies in mice show that encapsulated-IL-10 prolonged the biological half-life of IL-10 compared to naked IL-10. The immunotherapeutic effect of encapsulated IL-10 on inflammatory responses provides proof of concept for IL-10 application in autoimmune and inflammatory diseases. *This research was supported by funding from NSFCREST grant (HRD-1241701).*

OP-17. Novel Electrically Conductive Electrospun NanoScaffolds for Neural Tissue Engineering

Vinoy Thomas, Hillary Lam, Sarah Kezar, Haylie Reed, Candace Floyd
Department of Materials Science & Engineering University of Alabama at Birmingham

Nanostructured conductive scaffolds provide a biomimetic environment to nerve growth and guide the direction of repair. The electrical pulses delivered to the scaffold have been shown to improve neuronal wound repair, by mimicking the signal transduction of native nerve tissue. In this study, conductive melanin (5-10 wt%) was co-electrospun with a poly(lactic-co-glycolic acid)-zein blends into both random and highly aligned fibrous scaffolds for the first time. The scaffolds were characterized for chemical, structural and mechanical properties by FT-IR, DSC, SEM and tensile testing methods. Mechanical evaluation showed that the Young modulus increased with the incorporation of bioactive molecules such as zein and melanin into a PLGA scaffold. The modulus also increased with the change in orientation from randomly aligned fibers to highly aligned fibers. SEM analysis reveals a highly porous (~85%) nanofibrous morphology with fibers in the range of 100-400 nm, mimicking protein extracellular matrix (ECM) features (50-500 nm). Incorporation of 10-wt% melanin pigment decreased the electrical resistance of PLGA scaffold and scaffold possessed electrical conductivity comparable to that of 1-wt% MWCNT in polymer. Cell-materials interaction studies on the new conductive scaffolds using DRG explant or nerve cells are underway for spinal cord regeneration. *Grants from NSF-REU Site and UAB-CAS Multi-disciplinary Innovation Forum.*

OP-18. Remote Activation of Au-Polyurethane Composite Shape Memory Polymers

Christopher Ward, Maria Auad, Edward Davis
Polymer and Fiber Engineering, Auburn University

A gold nanorod polyurethane composite material (Au-SMPU) capable of exhibiting shape memory behavior is reported. The shape memory behavior is activated remotely by irradiation with NIR light. There are several potential biomedical uses of shape memory polymers including self-tightening sutures and size adjustable stents. However, one current limitation is the activation of the shape memory behavior. The traditional method, direct heating, is not suitable for most medical applications due to the need to directly contact the material with a heating element; this requires secondary invasive surgeries to alter geometries and the high temperatures can cause tissue damage. Several techniques have been investigated to remotely activate shape memory behavior including inductive heating

using oscillating magnetic fields, radio frequency irradiation, and electric fields. All of these techniques currently require large expensive equipment. The remote stimulation method utilized in this work requires only the application of nonionizing NIR light, at a frequency too which the body is largely transparent. The response is wavelength dependent, facilitating the development of devices that can undergo multiple shape changes. Synthesis of the composite material is reported. Standard shape memory behavior such as fixity and recovery, as measured by dynamic mechanical analysis, were found to be unaffected by the incorporation of the gold nanorods. Film samples produced from AU-SMPU respond within a few seconds to the application of NIR light and the amount of deformation recovered can be controlled by altering the irradiation time, the intensity of the irradiation, or the Au concentration.

OP-19. Use of DNA barcode amplification assay for detection of Salmonella Typhimurium and quantitative risk assessment of this method compared to other currently available methods

Mwinyelle Gregory, Temesgen Samuel, Reddy Gopal and Abdela Woubit
College of Veterinary Medicine, Nursing, and Allied Health
Department of Pathobiology, Tuskegee University

Salmonella is the leading cause of foodborne illnesses resulting in hospitalization and death in about 35% and 28% of total cases respectively in the United States (US). Every year, approximately 42,000 cases of salmonellosis are reported in the country. With the ever-increasing demand for high quality of food in the US and other parts of the world, it is critical to develop a highly sensitive, rapid, low-cost, easy to use and specific DNA barcode assay for the rapid and highly sensitive detection. The DNA barcode amplification assay is being developed for detecting Salmonella Typhimurium from solid and liquid food matrices. The DNA barcode-based PCR amplification will use highly specific-pathogen targeted DNA oligonucleotides in addition to millions of copies of DNA barcodes for extremely sensitive and specific detection, to potentially provide an excellent selective and sensitive performance. The two types of particles that will be used in this assay include magnetic and gold nanoparticles (Au-NP) with specific nucleotide recognition sites attached to both particles to sandwich the target DNA. In addition, the Au-NP will be functionalized with hundreds of thiolated single-strand oligonucleotide barcodes that will ultimately be used in RT-PCR detection. This is an on-going study that will incorporate quantitative risk assessment to compare this DNA barcode assay with other detection methodologies including the efficiency and limiting factors of different approaches used to-date.