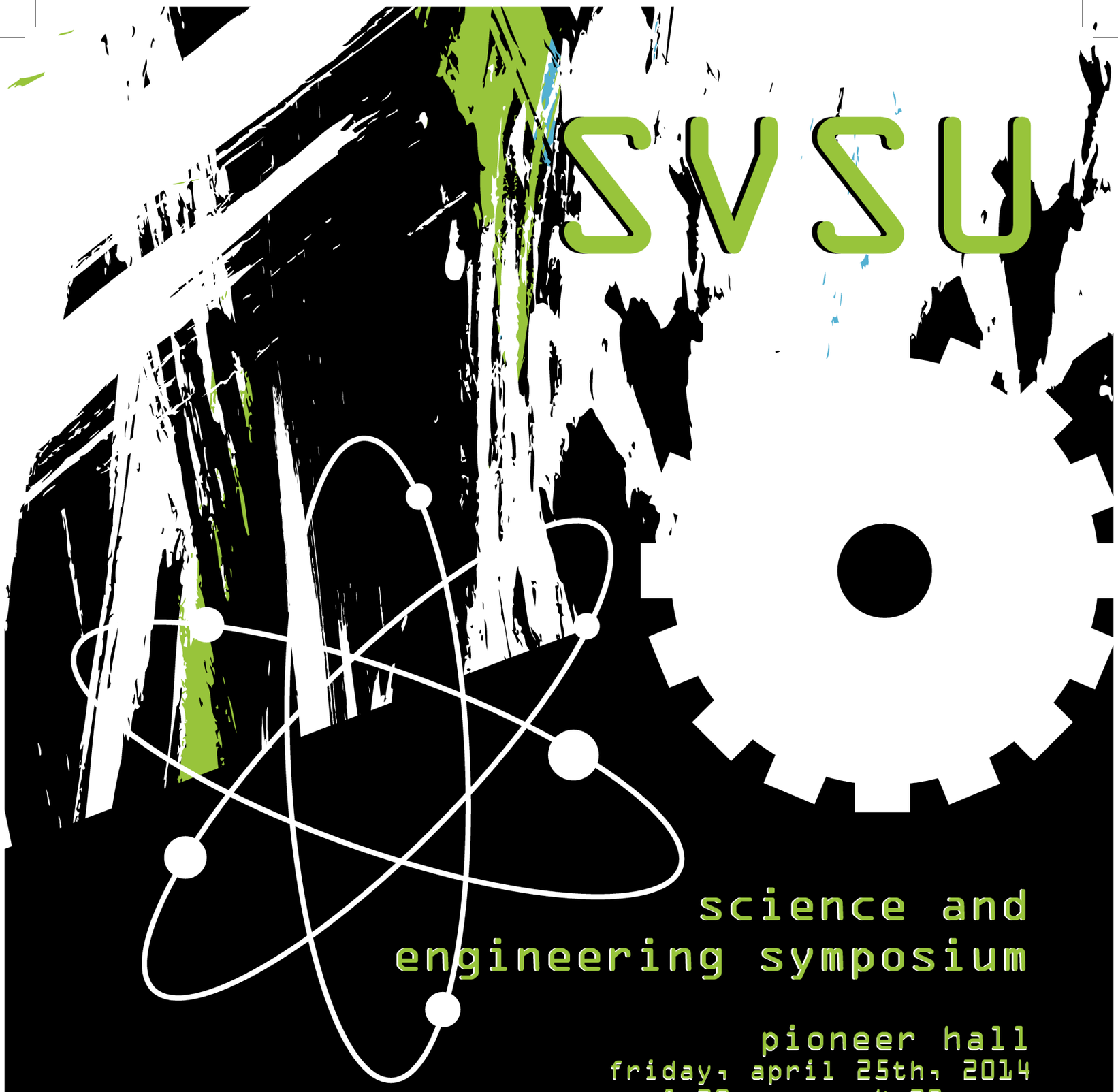

SVSU

science and engineering symposium

pioneer hall
friday, april 25th, 2014
8:30 a.m. - 4:30 p.m.

SVSU Saginaw Valley State University®

SVSU Science and Engineering Symposium

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SVSU Science and Engineering Symposium

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Keynote Lecture

Wicked problems, human nature, and a few other real-world challenges that you might not have faced in the classroom

Speaker: Dr. Steven G. Pueppke

Dr. Steve Pueppke is Associate Vice-President for Research and Graduate Studies at Michigan State University and serves as Director of Global and Strategic Initiatives in the College of Agriculture and Natural Resources. A Native of North Dakota, he has a BS degree from Michigan State University (1971) and a PhD degree in plant pathology from Cornell University (1975).

He held research positions at the University of Missouri-St. Louis and the University of Florida before becoming Chair of the Department of Plant Pathology at the University of Missouri in 1984. He later became Unit Leader of Plant Science there. He was a visiting professor at the University of Geneva, Switzerland (1989-90), and the University of Marburg, Germany (1996-97). Dr. Pueppke was Associate Dean for Research in the College of Agriculture, Consumer and Environmental Sciences at the University of Illinois from 1998-2006 and Director of MSU AgBioResearch from 2006-2013.

Dr. Pueppke has served on several boards and committees within the National Association of State Universities and Land-Grant Colleges and is the former chair of the Experiment Station Committee on Policy. He is a past president of the board of the National Council on Food and Agricultural Research and past chairperson of the National Agricultural Biotechnology Council. Since arriving at MSU, Dr. Pueppke has served on the USDA Advisory Committee on Biotechnology and 21st Century Agriculture and on the Michigan Renewable Fuels Commission.

He is a Fellow of the American Phytopathological Society and in 2008 received the Chevalier de l'Ordre des palmes Académiques from the Republic of France. Dr. Pueppke has published more than 125 peer reviewed papers over a 40 year scientific career. His current professional interests include agricultural biotechnology, 21st century food systems, and strategy.

Chemistry Research Posters

C01. Adsorption of Azadirachtin on Cellulose: Preparation of Sustainable Biomaterials

Olivia Sieggreen (Advisor: Dr. David Karpovich)

Research indicates that the limonoid azadirachtin, a component in the seed oil of the neem tree *Azadirachta indica*, exhibits insecticidal and fungicidal properties. Neem oil has been directly applied to wood, rope and other cellulosic surfaces as a preservative, but this practice consumes excess neem oil which has value. Application of the active limonoids without oil would be a less expensive and potentially just as effective. In this work, the adsorption of azadirachtin from a neem oil solution to a cellulose substrate was studied. Thermogravimetric analysis was used to confirm the presence of adsorbed material on a cellulose substrate. HPLC-UV-MS analysis was used to identify and quantify adsorbed components in methanol extracts. Our results indicate that azadirachtin exhibits a thermodynamic preference for physisorption on cellulose substrates and shows Freundlich isotherm behavior.

C02. Synthesis of Potential Anti-hyperglycemic C-Glycosides

Amanda Paris, Craig Tucker, and Jacqueline Spearman (Advisor: Dr. Jennifer Chaytor)

Type II diabetes is a metabolic disorder that is expected to affect 380 million people by 2025. This disorder, characterized by hyperglycemia, can lead to severe complications including neuropathy, cardiovascular disease and nephropathy. Development of new treatments for type II diabetes is essential as the number of patients with this disorder increases every year. Therapies controlling blood glucose levels would reduce both the risk of complications and the associated costs. O-glycosides lower blood glucose levels via inhibition of intestinal alpha glycosidase; however, these compounds are susceptible to hydrolysis in the body. C-glycosides are not susceptible to hydrolysis, and have similar three dimensional structures to O-glycosides. In this project, various C-glycosides will be synthesized by coupling a thioglycoside with a variable aromatic moiety. The synthetic pathway will be shown in this presentation. The anti-hyperglycemic potential of the synthesized compounds will be evaluated using UV enzymatic assays. The first synthesis was performed using galactose pentaacetate and acetophenone. The two coupling partners have been successfully synthesized and will be combined. Modification of the aromatic coupling partner will allow for a variety of aryl-C-glycosides to be synthesized and evaluated as potential anti-hyperglycemic agents. The results of this project to date will be discussed in the presentation.

C03. Chemical Synthesis & Structural Investigation of Stylissamide X
Cameron Volders (Advisor: Dr. Jennifer Chaytor)

The term cancer and its effects are recognizable world-wide. One particular issue of cancer is the ability of cancer cells to migrate, referred to as metastasis. Cancer metastasis is accountable for over 90% of cancer deaths. Therefore, anti-cell migration is a critical aspect of cancer research. In this project, a naturally occurring cyclic octapeptide stylissamide X[1] will be synthesized via solid phase peptide synthesis. The biological activity of this compound has been tested and has shown anti-cell migration properties, a property of importance to cancer researchers looking for a new strategy to combat the disease. Two synthetic attempts towards the stylissamide X structure were characterized to confirm the proposed spectroscopic results. Also, one modified structure of stylissamide X was synthesized in which one amino acid was replaced with an alternate amino acid in order to investigate its structure. In this presentation, the synthesis and characterization of stylissamide X will be discussed.

1. Aria, M. et al., Bioorg. Med. Chem. Lett., 2011, 22, 1818-1821

C04. Growth dynamics of precipitation structures
Patrick J. Fryfogle (Advisor: Dr. Jason J. Pagano)

Using reaction conditions far from equilibrium, we investigate the growth of hollow tubes formed from pellets. During the experiment, a single pellet is placed in a small volume of concentrated sodium silicate. Tube growth is directed by a single gas bubble. Systematic measurements include induction period and growth velocity. This poster presentation will discuss two distinct morphologies which have an intriguing link to the origin of life. Lastly, scanning electron microscopy reveals that the precipitation tubes have intricate patterns on the outside surface.

C05. Application of Tsuji-Trost Reaction to the Modification of Cephalosporin Antibiotics
Tyler Yachcik and Tyler Beyett (Advisor: Stephanie Brouet)

Increased bacterial resistance to current antibiotics is one of the most important challenges in medicine today. This rapid increase in resistance has forced scientists to find faster ways of producing new drugs. Typically, current antibiotics are modified to overcome bacterial resistance as this strategy is faster than synthesizing entirely new molecules. The 3rd generation cephalosporin antibiotic cefotaxime has been extensively modified using a three-step reaction scheme to produce several new generations of antibiotics. Our research is focused on developing a faster method for modifying a key position on cephalosporin antibiotics such as cefotaxime. We are taking advantage of the fact that the group at the position of interest is an allylic leaving group. Pd(0) catalyzed reactions, such as the Tsuji-Trost reaction, with allylic leaving groups generate a π-allyl complex that allows for the position to be modified in a single step and under mild reaction conditions. We have produced several compounds of interest that are currently undergoing characterization and demonstrate the usefulness of the Tsuji-Trost reaction in medicinal chemistry.

Chemistry Class Project Posters

C06. Enzyme Inhibition and Kinetic Study of Lipase

Micah Whitehead, Audrey Speckhard, and Christopher Ohmer (Advisor: Dr. Tami Sivy)

Several common over-the-counter drugs will be utilized to test the inhibition of the enzyme lipase. Lipases are used for digestion of food in our bodies to synthesize the fatty acids that we consume. An excess of fatty acids may cause problems in human health, such as high cholesterol, weight gain, heart attack, or an increase risk in diabetes. Doctors say one way to decrease a risk for heart attack is to take baby aspirin, if over the age of thirty-five; however, new research is coming to light that it could be harmful. The triacylglycerols for this experiment are extracted from a piece of cow fat via an isopropanol:hexane (3:2) organic extraction protocol and used to detect the activity of varying concentrations of lipase via spectrophotometer. It has been speculated there could be certain drugs that are easily attainable that could have an impact on fatty acid synthesis and metabolism. The household drugs naproxen sodium, acetaminophen, ibuprofen, and aspirin will be used with lipase and the substrate to possibly see a change in the amount of product produced via a colorimetric assay at 410 nm^{-1}. We predict that aspirin will cause a change in the enzyme kinetics while the other three major over-the-counter drugs will not, due to the risk factors associated with daily aspirin use.

C07. Enzyme Inhibition Assays of Cytochrome P450 Using Natural Remedies

Erin Campau, Abigail Elisech, and April Lukowski (Advisor: Dr. Tami Sivy)

Cytochrome P450 (CYP) enzymes are a family of monooxygenases that catalyze reactions with xenobiotics. Primarily found in the liver, cytochrome P450 enzymes metabolize many drugs and toxic substances. There are many different CYP enzymes within the family, and they are each specific to different substrates. Natural remedies tend to have profound effects on the ability of the enzyme to metabolize its intended substrate. This project seeks to evaluate the inhibitory effects of various natural remedies on three cytochrome P450 enzymes (CYP1A2, CYP2A6, and CYP3A4) obtained from cow liver. The natural remedies to be tested include turmeric, cumin, garlic, St. John's Wort, and fish oil. In the presence of these substances, the activity of the CYP enzyme metabolizing its intended substrate is expected to decrease. The enzyme activity will be assessed using spectrophotometry. The coenzyme associated with cytochrome P450 enzymes is NADPH, which has an absorption maximum at 340 nm. As NADPH is oxidized to NADP+, a decrease in absorption should be observed if the CYP enzyme is metabolizing its substrate. Information about the interactions of commonly ingested substances against drugs is valuable for healthcare providers in determining a suitable regimen and in maintaining patient safety standards.

C08. Genetic Sequencing and Enzymatic Structural Homology of Event-specific Maize Line NK603®

Patrick Fryfogle and Nicole Swope (Advisor: Dr. Tami Sivy)

Since the inception of organized society, successful agricultural pursuits have been pivotal to the longevity of human communities. Many astounding technological advances have helped bridge the ever-growing gap between agricultural supply and demand. One of the more controversial developments in the field of biotechnology is the implementation of genetically modified organisms, or GMOs. As a specific example, Monsanto markets NK603®, a genetically modified maize line which has resistance to N-phosphonomethyl glycine (glyphosate), publically known as Roundup®. The glyphosate resistance is conferred though the stable insertion of a gene from *Agrobacterium tumefaciens ssp*. The inserted gene sequence expresses glyphosate-tolerant 5-enolpyruvylshikimate-3-phosphate-synthase, (CP4 EPSPS) enzyme, which allows farmers to dose an entire field with herbicide, culling weeds while having no deleterious effects on their crops.

Deoxyribonucleic acid (DNA) was extracted and purified from various tissue samples of Roundup-Ready® corn cultivated in Tuscola County, Michigan. Extracted DNA was amplified through the use of polymerase chain reaction (PCR) and cycle sequenced using fluorescently labeled dideoxynucleotide triphosphates (ddNTPs). From the deciphered sequence, homology searches were completed to find closely related (homologous) proteins in other species. The amino acid sequences of the CP4 EPSPS enzyme and selected homologous proteins were then submitted to the I-TASSER server for protein structure and function predictions provided by the University of Michigan. Complete 3D renderings for each protein were constructed and allowed us to compare the core, binding sites, and overall structure for the designated enzymes.

C09. The Effect of Artificial Dyes on the Enzymatic Capabilities of Amylase

Andrew Schoenherr, Jackie Spearman, and Shelby Wright (Advisor: Dr. Tami Sivy)

Artificial dyes are more commonly used in food more than ever before and can be found in beverages, condiments, and various processed foods. Although they are heavily used, many of their potential side effects are not well understood. The goal of this experiment is to test the food dyes tartrazine, indigotin, and malachite green for their potential effects on amylase, the enzyme commonly used in the mammals to break down starch polysaccharides into individual sugar molecules. We hypothesized that the food dye molecules, because of their large, bulky nature, will have an effect on the hydrolysis reaction that is catalyzed by amylase. In the first portion of this experiment, a modified starch-iodine test using the naturally occurring amylase in *Escherichia coli* will be conducted on each of the three dyes. The second portion will attempt to quantify these effects using a spectrometer to determine to the rate of starch converted to glucose, and how this reaction is effected by the addition of these food dyes.

C10. Extraction and Spectral Characterization of Myoglobin

Amanda Paris, Hui Xu, and Brett Karl (Advisor: Dr. Tami Sivy)

Myoglobin is a protein that is responsible for the storage of oxygen within muscle tissue. The globular protein contains a heme prosthetic group and an iron atom. The oxidation state of this iron atom can be varied in-vitro using oxidizing or reducing agents. The different oxidation states of this protein have different affinities for oxygen and spectral characteristics. The form that is present in living tissues, oxy-myoglobin, is capable of binding oxygen when oxygen concentrations are high and releasing oxygen when the concentration is low. In this study, the different oxidation states of myoglobin will be characterized using UV-Vis absorption spectroscopy and Raman spectroscopy. To accomplish this, myoglobin will be extracted from bovine muscle tissue, purified through size exclusion chromatography and quantified using a standard curve obtained from external myoglobin standards. The molar extinction coefficient for both oxidation states of myoglobin will also be experimentally determined. Finally, the effects of high pressure treatment on the oxidation state of the protein will be investigated. The results of this project will be discussed in the presentation.

C11. The Occurrence of Mycosporine-Like Compounds in Human Skin Flora and their Ability to Function as a Natural Sunscreen

Zachary Devereaux and Alaina Nunn (Advisor: Dr. Tami Sivy)

Mycosporine-like compounds are known to be present in cyanobacteria, which inhabit environments subject to intense solar radiation. These compounds are able to counteract harmful rays and provide a natural sunscreen to the bacteria that possess them. It is of interest whether or not these compounds are present in small amounts among the human skin flora, and if so, if their presence increases when exposed to increasing amounts of radiation. In order to determine this, several swabs were taken from different parts of the body: arms, nose, and face, and cultures of bacteria were grown from these. Thecultures were then exposed to differing amounts of UV radiation, and any mycosporine-like compounds (MAA's) were extracted and quantified using UV-vis spectroscopy. It was found that MAA's are not present within the human skin flora naturally, but if the bacteria are exposed to enough radiation their appearance may be a possibility. Therefore, more work is currently being done so as to increase our knowledge of these compounds and their potential future benefits to human health.

Computer Science Posters

CS01. Exploring spoof attack against intrusion detection systems based on GUI application browsing behavior

Jacob Fenske, Dustyn Tubbs, and Gerald Henderson (Advisor: Dr. Khandaker Abir Rahman)

In this research we show one possible way of synthetically spoofing intrusion detection systems (IDS) that rely on Graphical User Interface (GUI) application browsing behavior. The attack is formulated by using publicly available GUI activity logging tools such as "Kidlogger" and hardware keystroke synthesizers "USB Rubber Ducky" for instance. In our experiments, we show that it is fairly easy to steal users' GUI interaction behavior and it is possible to build an automated attack system that synthetically injects the GUI activities into a system, therefore mimicking users' behavior profile. The goal of this attack is to gain unauthorized access to a system by breaking the security offered by the IDS in action. This research ultimately points out a weakness that is inherent in these security systems.

CS02. Development of a Customer Relations Management, Bid/Project Tracking & Service Ticket Management System

CIS 422/424 Class (Advisor: Dr. Scott James)

The CIS 422 and CIS 424 capstone class this year took on the development of a customized software system for a local Saginaw based security company. The software was designed from scratch using Visual Basic.NET 2012 and Microsoft SQL Server. All aspects of the project including requirements gathering, analysis, design, implementation, testing, delivery and training were conducted by the class.

Electrical Engineering Posters

Senior Design II

E01. Automatic Gate System
Michael Fugate, Filip Warzocha, James Hansen, and Ameen Alsinan (Advisor: Dr. Russ Clark)

The goal of this project was to create an automatic gate opener and closer for the garbage bins outside of Pioneer Hall. After speaking with Dr. Russell Clark and Mr. Stephen Hocquard, it was determined that we would be using solar power and a microcontroller to power and control the gates. As a group we determined that the gates outside of Pine Grove should be worked on first before moving the system to Pioneer Hall. We will be demonstrating a programmed and working Pic microcontroller for the system, along with researched suggestions for a future group to take into account while taking on the completion of the project.

E02. Cardinal Formula Racing Electronic Controls
Justin Dolane and Michael Gubody (Advisor: Dr. Russ Clark)

This design will provide SVSU's race team Cardinal Formula Racing with advance electronics to improve racing performance. It will feature a J1939 CAN system reading live engine data and displaying it to the driver on a HD LCD touch screen. The touch screen allows the driver to enter into different driving modes to manipulate the pneumatic shifting system as needed for different racing events. Warning lights and a RPM gauge that provides perfect shift points per gear will provide easy driver feedback. Since the 2008 R6 engine does not have a gear position indicator, we created a CAN system that measures RPM to driven wheel speed to determine if a proper shift occurred. Overall the system will display live data for trouble shooting, and a perfected shifting system to improve racing performance.

Mechanical Engineering Posters

Cardinal Formula Racecar

CFR. Aerodynamic Modification of the Cardinal Formula Racecar
Brandon Verhun and Trevor Haight (Advisor: Dr. Thomas Mahank)

In the spirit of competition, Cardinal Formula Racing at Saginaw Valley State University is exploring aerodynamic modifications to increase the aerodynamic grip of its racecar in an effort to improve acceleration, braking, and cornering speed. The study was inspired in part by a two-day workshop, presented by SAE International and attended by Cardinal Formula Racing team members, which addressed the fundamentals of vehicle aerodynamics. In the study the aerodynamic drag and lift on an NACA-0012 airfoil were investigated through wind tunnel testing and computational fluid dynamics (CFD) simulation. Good agreement was found between the experimental and numerical data for the angles of attack studied. The experimental data was then used to size an NACA-0012 airfoil for the racecar.

Senior Design I

M01. Inoculation Crucible Handling System (Richard Singer – Acra Cast)
Ali Alqanber, Michael Chapman, Brandon King, and Terry Martin
(Advisor: Dr. Brooks Byam)

An Inoculation Crucible Handling System is being designed for Acra Cast Investment Castings, a foundry in Bay City, MI. The purpose of our project is to develop a means by which a crucible containing 310 pounds of molten iron may be poured mechanically into an induction furnace. This 310 pound charge is double what their current maximum pour charge and will require one less person to perform, effectively saving the company money and providing a safer work environment.

M02. Advanced Engineering & Testing of tCMC for Defense Applications Client: Vince Alessi (Covaron)

Martin Savage, Fergus Fleming, Thomas Harrison, and Ahmed Alkhlil
(Advisor: Dr. Brooks Byam)

This project is to fulfill a functional requirement in applications seeking low density, high strength materials which retain their physical properties under high thermal loads. The main focus is to utilize Covaron's Thermosetting Ceramic Technology to make 'Thermosetting Ceramic Matrix Composites' (tCMC). Throughout this project, the unique techniques for combination of performance properties offered by PETRAFORGE materials and the process of determining optimum fiber type, length, and loading will attempt to increase select physical properties. This research is innovative; it will be a combination of a new-to-world material and composite design experiments which will be used to enhance performance in select defense applications. The tCMC developed could provide a wide selection of cutting-edge application possibilities for current and future defense applications. The newly developed tCMC should meet or exceed a flexural strength of 150 MPa as determined by a 4-point bend test per ASTM C1341-13. All safety standards should conform to the Material Data Safety Sheets (MSDS) of the materials utilized during the research process. The personnel at Covaron have agreed that all necessary equipment needed for laboratory experiments will be provided however the research project must be conducted within a predetermined budget of $5000. In order to demonstrate the physical properties of the new tCMC, a radome for a Cuda hit to kill missile will be constructed. The radome will be 5.5 inches in diameter, 6.5 inches in length, 0.5"-0.75" thick, and of a conical shape.

M03. Motorcycle Front Wheel Conversion

Joel Parsons, Fadul Ashkanani, and Zhiheng Zhang (Advisor: Dr. Thomas Mahank)

Although motorcycles can be fun to ride and very gas efficient, their downfall is the short riding season. To get around this drawback a design group from Saginaw Valley State University's mechanical engineering department are working in cooperation with Terry Duperon to develop an attachment which will allow the rider to replace the front wheel of their motorcycle with a two wheeled system which will allow for the use in harsher weather and road conditions, thus extending the riding season for motorcycles. The design objectives are to allow the same maneuverability that a current motorcycle has. These maneuverability constraints are to be held by the motorcycle being provided, a 2000 Harley Davidson Road King. This product has to be able to attach to the forks of the motorcycle with temporary support to the frame if necessary, allow the motorcycle to stand alone without use of a kick-stand, lean capabilities are to be held within 32 degrees of vertical, handlebar turn angle will be 32.5 degrees from straight, seat height I to be held to +/- 1 inch from 29 inches, the wheel base is constrained to 30 inches between the tires, and a cost maximum of 10000 dollars.

Mechanical Engineering Posters

Senior Design II

M04. Covenant Healthcare Sharp Removal Project
Robert Short, Luke Gembrowski, and Cedric Moreau (Advisor: Dr. Brooks Byam)

Covenant HealthCare presented a need to cut costs through lowering the amount of medical waste produced in their facilities. Covenant is the sixth largest health care facility in Michigan. Covenant employs over 4200 employees with over 500 physicians on their medical staff. There is over 85,000 visits per year ranging from cardiology, orthopedics, robotic surgery, and many others. Covenant's Innovation Center is leading the investigation into the medical waste issue. To cut down on the amount of waste, it was decided that a device or system needed to be developed to remove the 'sharp' or needle from The BD Vacutainer® Urine Collection lid. The Vacutainer® is a device used for urine collection.

M05. General Motors Piston Pin Conveyor Redesign
Michael Herbolsheimer, Nicholas Wilson, and Laurene Majani
(Advisor: Dr. Thomas Kullgren)

The goal of this project is to introduce an automated spacing mechanism to the piston pin manufacturing line of GM, Bay City. Current processes include a random and unequally spaced transfer of pins to an eddy current testing system. The lack of consistent spacing causes a large amount of rejected pins because of improper testing. The new system will utilize a programmed rotary actuator to adjust the position of pins at an adjustable cycle time that allows for sufficient testing of each pin.

M06. Hand-braking Controls for Michael Johnson's Mazda Pro Series Racecar
Gaspard Buet, Michael Hickey, and Michael Howard (Advisor: Dr. Brooks Byam)

This system is being designed to reduce the fatigue on Michael Johnson and aid in the advancement of his racing career. The system removes the constant muscle strain on the arms by assisting the mechanically actuated system with an electronically actuated design that matches the speed and force requirements of the braking system. This will eliminate the required 155 pound input force down to an average force of 6 pounds and can be adjustable through different torsional springs.

Mathematical Sciences Posters

MS01. Tangent Line/Plane Approximation of Definite Integrals

Meghan Peer (Advisor: Dr. Emmanuel Ncheuguim)

The purpose of this presentation is to share a new method of approximate integration utilizing tangent lines and tangent planes in both two-dimensional and three-dimensional spaces. This method will be compared with already existing methods in terms of efficiency and error. This presented method of definite integral approximation will likely be of value to mathematics and the applied sciences, as the majority of integrals cannot be solved computationally. Despite limitations, the tangent line/plane approximation demonstrates that integrals can be approximated to nearly exact solutions.

MS02. Modern Portfolio Theory: A Model for Superior Risk-Adjusted Returns

Rebecca Young (Advisor: Professor Curtis Grosse)

Investment decisions should account for both return and risk when investing in the stock market. Expected investment return calculations without proper consideration of risk reduction can lead to failure of meeting financial goals. Using statistical measures of risk such as standard deviation and semi-deviation, we consider various portfolios that minimize these measures. Statistical correlations among the candidate positions are key considerations. Specifically, our stock selection process used is a market neutral approach. This model largely eliminates correlation of the portfolio to the overall stock market. This approach can be used on its own or as a complement to an existing financial portfolio, such as a 401(k) retirement account. It would have provided a buffer to the portfolio during periods such as the credit crisis of 2008. No one knows when the next crisis will occur nor how severe the affect will be on financial portfolios. By incorporating this proposed strategy, that uncertainty becomes less important for meeting financial goals.

Physics Posters

PH01. Fabrication and Optical Fourier Analysis of a Ronchi Ruling Diffraction Grating
Amanda Wickens (Advisor: Dr. Marian Shih)

The Fourier Transform is a mathematical operation used to transform signals from the time domain to the frequency domain. In the field of coherent optics, the analogous operation transforms spatial transmittance variations into the spatial frequency domain. This work describes the fabrication of Ronchi ruling diffraction gratings using a photo-reduction method, and the experimental evaluation of their optical Fourier Transform. Each amplitude transmission grating was characterized using an imaging lens in order to analyze the spatial frequency spectrum at the Fourier transform plane. Measurement of the intensities of the different diffraction orders, and subsequent numerical analysis, reveal agreement with the amplitudes of the spatial frequency components of the original output signal predicted by Fourier analysis theory.

PH02. Solution of an open spin ½ XXZ quantum spin chain for $\eta=i\pi r/q$
Chris Silverthorn (Advisor: Dr. Rajan Murgan)

A mathematical solution known as the Bethe ansatz equations which describe the energies of a quantum mechanical model known as the open spin 1/2 XXZ quantum spin chain is presented. A crucial parameter that describes this model is the bulk anisotropic parameter, η. The case where this parameter assumes the values, $\eta = i\pi r/q$, with r and q representing arbitrary positive integers (odd integers for q), is examined. Equation describing the energy levels of this open quantum spin chain model is derived. Some numerical results are also tabulated.

Oral Session A: Biology

Room: Pioneer-242

Morning Session: 10:30am-noon

B01. Effects of Styrene Exposure on Neurobehavioral Measures of Development in the Norway Rat *(Rattus norvegicus*)

Nancy Q. Lackey, Jacob D. Carlsile, Madison S. Lackey, Jennifer Mielke, Miranda L. Strasburg, and Thomas Taugher (Advisor: Dr. Gary Lange)

In the modern world, our environment contains a large array of man-made chemicals that contribute to our societal progress and prosperity, but also can exert unforseen negative impacts on our well being. Styrene, a suspected endocrine disruptor, is widely used in the manufacture of polystyrene which is a major plastic used in the food service and handling industries. Previous research suggests that styrene can exert an estrogenic effect and it can also exert an effect that mimics metabolic hormones. This study assesses the effects of styrene across a multi generational exposure in the Norway rat (*Rattus norvegicus*). Exposure prenatally and postnatally as well as across generations could potentially induce far different effects on growth, development and behavior than has been seen in previous work. Specifically in this presentation, focus is on how styrene exposure has shaped an array of neurobehavioral measures related to development across multiple generations. Specific emphasis will be on discussing measures such as the neonatal righting response, performance in the elevated plus maze, performance in the open field test and behavioral measures of reproduction. These data are compared to control populations.

B02. Effects of Styrene Exposure on Physiological Measures of Development in the Norway Rat (*Rattus norvegicus*)

Nancy Q. Lackey, Jacob D. Carlsile, Madison S. Lackey, Jennifer Mielke, Miranda L. Strasburg, and Thomas Taugher (Advisor: Dr. Gary Lange)

In the modern world, we are exposed to a large array of man-made chemicals designed to help improve day-to-day living, but these same compounds can also potentially exert unforseen negative impacts on our physiological health and well being. If these chemicals alter or interfere with the endocrine system, they are collectively referred to as endocrine disruptors. Styrene, a suspected endocrine disruptor, is widely used in the manufacture of polystyrene plastics. Plastics such as these are used in the food service industry, and a great number of our foods and beverages are held and/or stored in polystyrene containers. Several studies suggest that styrene can exert both an xenoestrogenic effect and also a metabolic effect that alters thyroid hormone physiology. This study assesses the effects of styrene across a multi generational exposure in the Norway rat (*Rattus norvegicus*). Exposure prenatally and postnatally as well as across generations could potentially induce far different effects on growth, development and physiology than has been seen in previous work. Specifically in this presentation, focus is on how styrene exposure has shaped physiological measures related to development. Emphasis will be on discussing measures of weight, anogenital distances, grip strength, litter sex ratios, and locomotor behavior of rats exposed to styrene. These data are compared to control populations.

B03. Effects of Styrene on Measures of Development, Metamorphosis, and Behavior of the Fruit Fly (Drosophila melanogaster)

Kelsey Gere and Vanessa Wolf (Advisor: Dr. Gary Lange)

Endocrine disrupting compounds are those that exert effects on aspects of the neuroendocrine system in organisms, and may alter an organism's physiology, morphology, development and/or behavior. Styrene, a suspected endocrine disruptor, is widely used in the manufacture of polystyrene. This plastic is extensively used in the food service and handling industries. Previous research suggests that styrene can exert an estrogenic effect and it can also exert an effect that mimics metabolic hormones in mammalian systems. This study assesses the effects of styrene in the invertebrate animal model of the fruit fly (*Drosophila melanogaster*). Environmentally relevant exposures could induce effects on growth, development and behavior in the invertebrate system even though their hormone profile is vastly different than that seen in mammals. Specifically in this presentation, focus is on how styrene exposure has affected rover/sitter behavior in larvae, pupation heights in pupae, and locomotor measures in adult flies. These data are compared to control populations.

B04. Effects of Bisphenol-A on Development, Metamorphosis, and Behavior of the Fruit Fly (Drosophila melanogaster)

Allison Collier and Justine LaPlant (Advisor: Dr. Gary Lange)

Bisphenol- A is a chemical that is used widely as a plasticizing agent in the manufacture of a variety of plastics. The types of plastics containing bisphenol-A are quite varied and including many forms used in food handling and storage. Implicated as an endocrine disrupting compound in several vertebrate organisms, the effects of bisphenol-A have varied in different regions and different tissues of the body, but most vertebrate work has suggested a xenoestrogenic effect as its primary action and the alteration of metabolic function as secondary. However, little assessment of the potential of this compound to affect growth, development and behavior in invertebrates has thus far been undertaken. Therefore, in this study, we use the fruit fly (*Drosophila melanogaster*) to assess the endocrine disruption potential of bisphenol-A in an invertebrate model. Our work reports on key developmental effects, impacts on stages and morphologies of metamorphosis, general fecundity, and on neurologically associated aspects of behavior.

B05. Bioremediation of dioxin and furan contaminated soils

Dr. James L. McEvoy

Dibenzo-p-dioxins (DD), dibenzofurans (DF), and their polychlorinated derivatives (PCDD and PCDF) are produced by incineration processes and as by-products of many chemical reactions. These and related compounds are known to impose undesirable effects on the environment and animals including man. Although quite persistent once in the environment, these compounds are known to be biodegraded by a few specific microorganisms such as the bacteria *Sphingomonas wittichii* and *Pseudomonas veronii* and the fungi *Aspergillus toxicarius*, *Cordyceps sinensis*, *Cunninghamella elegans* and several species of *Trichosporon*. Using a selective enrichment technique we will be screening DD, PCDD, DF, and PCDF contaminated soils along the Tittabawassee and Saginaw rivers near Saginaw, MI for potential bioremediation microorganisms that can grow in the presence of these toxic compounds or utilize them as a sole carbon source. Alongside the traditional microbiological approach, we will also screen the contaminated soils for presence of specific biodegrading organisms via a quantitative PCR approach. Experimental approaches and techniques will be discussed.

B06. New Animal Species Discovered in Michigan and Elsewhere
Dr. Stephen W. Taber

Six new insect species from Michigan and Utah are discussed with photographs and descriptions of the animals and their habitats. Most are flies that are thought to breed in wetland fungi. One is a crane fly from high western desert.

B07. Molecular Markers in Hybridization of American Black Ducks and Mallards
Brandon Revard (Advisors: Dr. Gail Kantak and Dr. David Stanton)

The American Black Duck was once the most abundant duck in North America and a species greatly prized by hunters. However, the geographic range of the American Black Duck currently is shrinking due to habitat loss and to hybridization with the more abundant and widespread Mallard. Identification of hybrids is difficult, making population monitoring and assessment of the hybridization issue problematic. The goal of this research is to identify a suite of molecular markers capable of distinguishing hybrids from the parental species. Progress to date includes building the sample size to 298 feather specimens collected from American Black Ducks, Mallards, and hybrids from 29 states; completion of DNA extractions for all samples; and PCR amplification of known genetic markers for most of these. Preliminary results from analyses of the microsatellite fingerprint data produced so far show differences in allele frequencies and other genetic parameters which may prove useful in identifying hybrids.

B08. DNA fingerprinting of Michigan Tiger Swallowtails (*Papilio glaucus*)
Travis Washburn (Advisor: Dr. David Stanton)

Two recognized species of Tiger swallowtail butterflies exist in Michigan, the eastern tiger swallowtail (*Papilio glaucus*) and the Canadian tiger swallowtail (*Papilio canadensis*). The ranges of these two species are primarily determined by climate and vegetation, with the eastern species predominant in the southern portion of the lower peninsula and the Canadian predominant in the upper peninsula. The two species are known to hybridize in the northern portion of the lower peninsula. However, the two species are morphologically similar and it is difficult to distinguish hybrids based on morphology. Genetic markers are needed in order to more effectively track the hybrid zone and to determine how it changes over time in response to climate change. Samples were collected in the summer of 2012 and 2013 at Oxford swamp in Newaygo County, Michigan. DNA extraction was performed followed by PCR and Capillary electrophoresis. Data was obtained for five polymorphic loci. This data should provide sufficient resolution for the identification of species specific markers that will allow for more reliable identification of hybrids and a more detailed analysis of gene flow within the hybrid zone.

B09. DNA fingerprinting of Saginaw Bay Walleye (*Stizostedion vitreum*)

Stephanie Zawacki, Michael Larges, and Eric Palmer (Advisor: Dr. David Stanton)

There is a large population of walleye in Saginaw Bay that is both economically and ecologically important. The population is heavily managed and has undergone significant variation in size in recent years. In order to properly manage this population, genetic information is required. DNA fingerprinting data for walleye populations within Saginaw Bay was compared to that obtained for spawning river populations. We obtained fin clips from walleye captured at the Freeland Walleye Festival in the spring of 2012 and 2013. With the help of the Department of Natural Resources (DNR), we also obtained fin clips from a spawning population of walleye on the Tittabawassee River in the spring of 2013. In total, over 250 fin clips were obtained. DNA was extracted, PCR amplification and capillary electrophoresis was performed in order to determine genotypes for three fingerprint loci. This data provides genetic markers that allow for the assessment of genetic diversity and population substructure, as well as the determination of important spawning sites and assessment of spawning site fidelity. This information will aid management decisions regarding stocking programs, as well as decisions regarding damming of rivers and the construction of ladders to be used by spawning walleye.

B10. DNA fingerprinting of zebra mussels (*Dreissena polymorpha*) from Michigan inland lakes

Diamond Taylor and Shannon Duby (Advisor: Dr. David Stanton)

Zebra mussels are an invasive species introduced into the Great Lakes from Europe in 1986. Since then, they have spread aggressively throughout the United States and they have had a dramatic effect on water quality and biodiversity. Genetic studies of invasive species are critical in determining the viability and potential ecological impact of these populations. In order to assess genetic variation, population substructure and patterns of gene flow, samples were collected from several inland lakes in the Michigan. These populations were compared to sites in Lake Michigan and Lake Huron in order to establish if source populations could be determined. DNA was extracted from frozen samples and PCR was performed in order to amplify polymorphic fingerprint loci. The PCR products were analyzed using the CEQ 8000 automated DNA analysis system from Beckman-Coulter. Fragments sizes were determined and genotypes were identified using internal reference standards. The parameters investigated included number of alleles, observed (Ho) and expected (He) heterozygosity, population substructure (FST) and genetic distances (D) between populations. The results show that most inland lakes have received migrants from many different locations, including distant sources. Most likely, gene flow due to continuing human transport is responsible for the pattern observed.

Oral Session B: Electrical Engineering Senior Design — Room: Pioneer-240

Presentations start at 1:00pm

Senior Design II

(see Page 10 for abstracts)

E01. Automatic Gate System
Michael Fugate, Filip Warzocha, James Hansen, and Ameen Alsinan
(Advisor: Dr. Russ Clark)

E02. Cardinal Formula Racing Electronic Controls
Justin Dolane and Michael Gubody
(Advisor: Dr. Russ Clark)

Senior Design I

E03. Covenant Healthcare Fall Prevention
Troy Watkins, Zach Streeter, Kyle Sponseller, and Abdullah Ali
(Advisor: Dr. Rajani Muraleedharan)

Health and safety are the most important elements to consider for a hospital environment. One of the chronic problems that all hospitals face are patient falls. This situation causes burden not only on the hospitals, but also the patient's family members. In this project, a technology that can assist patients from falling is proposed that will eliminate a lot of complications and risks for everyone involved. The proposed design monitors patient’s movement or disruption, and communicate an alarm to the nurses before a fall is detected. The proposed motion sensing technology is the best way to achieve the required specifications because of its accuracy, mobility, and ease of use. Also, designed system should be mobile and reduced complexity to provide accessibility to any patient’s room.

E04. SVSU Smart Parking System

Addison Pafford, Frederick Sample, and Sam Campbell
(Advisor: Dr. Rajani Muraleedharan)

Over the past decade the size of Saginaw Valley State University's (SVSU) student population has consistently increased, which has led to increased recruitment of professors, staff, and the infrastructure on campus. However one of the primary concerns is the existing parking accommodations, as insufficient parking spaces impacts traffic congestion, driver frustration and air pollution. The cost for expanding parking space is high and therefore applying technologies for smart management of the existing parking areas is essential. A smart parking system will be developed for SVSU's Campus Police and Parking Services that can accommodate for the increased needs of the university population. The developed prototype will monitor vehicles entering the parking lot as well as send a notification to Campus Police if there is any unauthorized parking. Ideally, the developed prototype will perform under different weather conditions and provide a tool that can be applied on a large scale for all parking lots at SVSU. Our proposed system will pave the way for green environment on SVSU's campus, and also reduce the carbon footprint of the planet earth.

E05. McGaw Strain Gauge Module

Michael Mondeau, Kye Sugden, Greg Tacey, and Dave Plant
(Advisor: Dr. Rajani Muraleedharan)

Strain gauges are used in a wide variety of applications from multi axial stress fatigue testing to bending and deflection measurements. Commercially available modules used to measure the strain provided by the gauges can be quite expensive. This becomes evident especially when considering temperature correction due to voltages in the leads connecting the strain gauges to the modules. In this project a lower cost alternative to commercially available strain gauge modules, with high resolution measurements will be developed. Furthermore, the method for reading strain using traditional Wheatstone bridge method causes the need for temperature correction. Therefore, the decay time of capacitor voltage is used as measurement technology, which effectively eliminates the temperature correction. Also, the need for an external analog to digital converter as the measurements is taken over time arises. The developed module has the ability to be used in offsite locations due to the size and low power consumption used by the time measurement IC. The result is a flexible use of strain gauge module with high precision strain measurements at a low cost to the consumer.

Oral Session C: Mechanical Engineering Senior Design I **Room: Pioneer-243**

Presentations are 30 minutes each, starting at 1:00pm (see Pages 11-12 for abstracts)

M01. Inoculation Crucible Handling System (Richard Singer – Acra Cast)
Ali Alqanber, Brandon King, Michael Chapman, and Terry Martin
(Advisor: Dr. Brooks Byam)

M02. Advanced Engineering & Testing of tCMC for Defense Applications Client: Vince Alessi (Covaron)
Martin Savage, Fergus Fleming, Thomas Harrison, and Ahmed Alkhlil
(Advisor: Dr. Brooks Byam)

M03. Motorcycle Front Wheel Conversion
Joel Parsons, Fadul Ashkanani, and Zhiheng Zhang
(Advisor: Dr. Thomas Mahank)

Oral Session D: Mechanical Engineering Senior Design II **Room: Pioneer-245**

Presentations are 30 minutes each, starting at 1:00pm (see Page 13 for abstracts)

M04. Covenant Healthcare Sharp Removal Project
Robert Short, Luke Gembrowski, and Cedric Moreau
(Advisor: Dr. Brooks Byam)

M05. General Motors Piston Pin Conveyor Redesign
Michael Herbolsheimer, Nicholas Wilson, and Laurene Majani
(Advisor: Dr. Thomas Kullgren)

M06. Hand-braking Controls for Michael Johnson's Mazda Pro Series Racecar
Gaspard Buet, Michael Hickey, and Michael Howard
(Advisor: Dr. Brooks Byam)

Oral Session E: Computer Science and Chemistry

Room: Pioneer-247

Presentations start at 1:00pm

Exploring spoof attack against intrusion detection systems based on GUI application browsing behavior

Jacob Fenske, Dustyn Tubbs, and Gerald Henderson
(Advisor: Dr. Khandaker Abir Rahman)

In this research we show one possible way of synthetically spoofing intrusion detection systems (IDS) that rely on Graphical User Interface (GUI) application browsing behavior. The attack is formulated by using publicly available GUI activity logging tools such as "Kidlogger" and hardware keystroke synthesizers "USB Rubber Ducky" for instance. In our experiments, we show that it is fairly easy to steal users' GUI interaction behavior and it is possible to build an automated attack system that synthetically injects the GUI activities into a system, therefore mimicking users' behavior profile. The goal of this attack is to gain unauthorized access to a system by breaking the security offered by the IDS in action. This research ultimately points out a weakness that is inherent in these security systems.

Synthesis of Gadolinium-Silica Tubes

Daniel P. Weller
(Advisor: Dr. Jason J. Pagano)

Chemical garden reactions provide insight into the growth dynamics of numerous non-equilibrium systems found in nature. One such example is the hydrothermal vents found deep in the ocean which self-assemble into tubular hierarchical structures. In this work, we present the synthesis of gadolinium (III) hydroxide tubes grown by chemical garden precipitation, post-synthetic processing by thermal decomposition to gadolinium (III) oxide tubes, and an experimentation of their material properties. The tubes are produced in the jetting and/or budding regime yielding highly linear and reproducible tubes. We report TGA-DTGA, SEM, and IR measurements for the as synthesized and processed tubes.