**CEAT State Fiscal Year 2015 Active Awards**

**Architecture**

**Deployable Greenhouse for Food Production on Long-Duration Exploration Missions**

The project is to design, develop, build and test a deployable greenhouse system for the X-Hab

Academic Innovation Challenge. Goals of the project include the short-term goal of an

interdisciplinary senior design project to design, build and evaluate a horizontally oriented

habitat and a long-term goal to develop capabilities in education, research, and outreach in the field of space habitat design. This will include both technical engineering and outreach efforts. Faculty with diverse specialties from across the schools at OSU will participate in the project with the goal of developing technology and designs to facilitate human habitation in outer space.

**Sponsor:** National Space Grant Foundation for NASA

**PI/PDs:** Steve O’Hara

Mechanical and Aerospace Engineering: Jamey D. Jacob

Industrial Engineering & Management: J. Cecil

Biosystems and Agricultural Engineering: Paul Weckler, Ning Wang

**Emergency Egress Standards Film**

Although there are numerous emergency egress training videos, those videos focus on developing emergency evacuation plans. An educational film focusing on emergency egress building design strategies and hazard identification in accordance with the standards is not known to exist. A 45-minute film will be created as a learning resource to be integrated into undergraduate courses to educate students about the importance and content of documentary standards related to building egress. The film will be targeted to students in fire protection, architecture, and civil engineering; however, training on this topic would be applicable to workers and/or employers in almost any workplace.

**Sponsor:** U.S. Department of Commerce National Institute of Standards and Technology

**PI/PDs:** Jeanne Homer

Fire Protection & Safety Engineering Technology: Bryan Hoskins

**Center for Local Government Technology (CLGT)**

**Road Safety Assessment for the Cheyenne & Arapaho Tribes**

American Indian Tribes conduct road safety audits as part of their transportation planning programs. The purpose is to assist with determining roadway deficiencies, maintenance issues and planning for future work that benefits transportation safety. Road Safety Audits are formal evaluations of tribal roadways by independent, multi-disciplinary teams to identify specific safety recommendations. RSA teams identify safety risks using information sources such as crash data, maintenance logs, interviews of roadway authorities, public testimony, and field observations. This project will assist the Cheyenne & Arapaho Tribes in conducting a road safety audit by supplementing existing staff with specialized technical expertise.

**Sponsor:** University of Oklahoma for the Southern Plains Transportation Center for the Oklahoma Department of Transportation SPR

**PI/PD:** Karla Sisco

**Accelerating Safety Activities Program (ASAP)**

The purpose of this agreement is to provide a continually operating program of technical assistance, research and training services for Oklahoma Department of Transportation functions through resources made available by OSU through the Center for Local Government and Technology and its Tribal Technical Assistance Program (TTAP).

**Sponsor:** Oklahoma Department of Transportation

**PI/PDs:** Jim Self, Karla Sisco

**Local Technical Assistance Program**

Since its inception in 1982, the mission of Oklahoma LTAP has been to provide training, technology transfer and technical assistance to local government agencies responsible for transportation systems. The Center is one of four original LTAP centers in the nation. Oklahoma LTAP addresses four broad focus areas: Safety, Infrastructure Management, Workforce Development, and Organizational Excellence. LTAP also provides a Transportation Intern Program that places student interns with local government agencies in paid summer internships.

**Sponsor:** Oklahoma Department of Transportation

**PI/PDs:** Douglas A. Wright, Michael Hinkston

**Oklahoma's Public Rural Transit Systems**

In cooperation with ODOT’s Transit Program Division, CLGT will provide 2- 5 educational programs for Oklahoma’s rural public transit personnel. Programming activity shall include educational sessions provided through presentations at statewide meetings as well as other locations. Specific educational programs include: Oklahoma Rural Public Transportation Training Retreat, Oklahoma Transit Association Bus Roadeo Training, Dispatcher Certification Course, Transit 101 for Rural Transit Directors, PASS Driver Certification Training Classes, National Safety Council Defensive Driving, and Drug and Alcohol Program Training to ODOT staff

**Sponsor:** Oklahoma Department of Transportation for Federal Transit Administration

**PI/PD:** Darla Hisey

**Southern Plains Tribal Technical Assistance Program (TTAP) Center**

Funded by the FTA and in cooperation with the Bureau of Indian Affairs, this program provides a resource center to furnish information, training, and technical assistance related to road and bridge construction, repair, and maintenance to over 49 tribal governments in a four-state area. The TTAP mission is to meet the educational needs of tribal governments related to roads, bridges, public transit, transportation systems, inter-governmental coordination, and economic development. An important part of the mission is to provide training sessions, classes, and workshops geared to specific tribal needs. OSU’s TTAP center is one of seven TTAP centers across the U.S.

**Sponsor:** United States Department of Transportation - Federal Highway Administration

**PI/PD:** Jim T. Self, K. Sisco

**County Computer Assistance Program**

With oversight provided by the Oklahoma Tax Commission (OTC), the Association of County Assessors, and the Association of County Treasurers, the Center for Local Government Technology provides software programs, support of software and hardware including installation, maintenance of software and hardware, data management, conducting training programs and technical assistance for County Assessors and County Treasurers. CLGT also provides coordination with the Oklahoma Tax Commission Ad Valorem Division (OTC) in fulfilling mutual responsibilities to support State CAMA and Assessment Administration (AA) software systems.

**Sponsor:** Oklahoma Tax Commission

**PI/PDs:** Gary Snyder, Scott Warren

**Assessor Training and Assistance Program**

CLGT, in cooperation with the Tax Commission, the County Assessors' Association and the County Treasurers’ Association will execute the PROGRAMS by providing computer software programs, support of software and hardware including installation, maintenance, data management and training, to counties currently using the services previously provided by the State Auditor and Inspector as mandated by legislation. CLGT will provide: hardware maintenance, software, software maintenance, and software support to County Assessors utilizing the PROGRAM software systems; technical support and training to County Assessors; and assistance with data extraction for OTC statutory and other agency requirements.

**Sponsor:** Oklahoma Tax Commission

**PI/PDs:** Gary Snyder, Scott Warren

**Southern Plains Transportation Center 2014 Summer Intern Program**

SPTC is providing partial funding to CLGT for three internships the summer of 2014. CLGT’s LTAP/TTAP programs will provide the remaining support for the three internships. These internships will be awarded for a period of approximately twelve weeks to students from a transportation related degree program located at the universities in Oklahoma affiliated with the SPTC - Langston University, the University of Oklahoma and Oklahoma State University. The internships will be modeled on those conducted by CLGT over the past four years.

**Sponsor:** University of Oklahoma for the Southern Plains Transportation Center for US Department of Transportation

**PI/PDs:** Doug Wright, Michael Hinkston

**Chemical Engineering**

**SI2-SSE: Development of Cassandra, a General, Efficient and Parallel Monte Carlo Multiscale Modeling Software Platform for Materials Research**

Responsibilities of the OSU research team include: 1) PI Shah will lead the effort to describe the features, capabilities and performance of Cassandra in the form of a research publication; 2) The OSU team will incorporate slow growth methods such as continuous fraction component Monte Carlo methods for phase equilibria calculations; 3) Cassandra will be modified to enable Monte Carlo simulations of thermophysical and phase equilibria calculations in mesoporous materials such as zeolites, metal organic framework, carbon nanopores and carbon nanotubes; 4) PI Shah will contribute to the summer workshops as a part of the outreach efforts.

**Sponsor:** University of Notre Dame for NSF

**PI/PD:** Jindal Shah

**Mathematical Modeling of Podocytes in Diabetic Kidney Disease**

The goal is to use mathematical modeling to investigate and predict the onset of nephropathy in advance of detection of clinical biomarkers by describing the mechanism of podocyte damage and loss. While models have been proposed for various renal physiological processes, a quantitative description of the dynamics of podocyte injury at the onset and during the progression of DKD is needed. Such a model can be used to improve understanding of the complex network of events involved in DKD and to test the impact of potential pharmaceutical drugs on vulnerable target segments of the mechanism as elucidated by the model.

**Sponsor:** University of Oklahoma Health Sciences Center – Harold Hamm Diabetes Center

**PI/PD:** Ashlee Ford Versypt

**Gas Evolution Rates in Hydrocarbons as a Function of Flow, Temperature, and Pressure for Gas/Liquid Separator Applications**

The long range goal is to develop a methodology to measure gas evolution rates in the field for gas/liquid separator design and troubleshooting applications. This project is the first step toward achieving this goal. The work objectives are to establish an experimental protocol to measure gas evolution rates in flowing conditions, create a milestone roadmap for developing a gas evolution test program, and propose a commercially viable experimental methodology for further field testing. Completion of this work will provide the necessary information to perform the longer range work for a larger project that might include the establishment of a JIP.

**Sponsor:** Chevron U.S.A., Inc.

**PI/PD:** Clint Aichele, Sayeed Mohammad, Rob Whiteley

**Philips 66 Wax Characterization Project**

This research will provide better understanding of the interaction between oilfield contaminants and asphaltenes and paraffins in crude oil blends. The results will establish the path forward to determine how to prevent or mitigate unexpected fouling in crude furnaces and desalters when running Eagle Ford crude blends. The work includes a literature survey, laboratory measurements of wax precipitation using cross-polarized microscopy under heated, shear conditions, and measurement of other wax behavior attributes using interfacial tensiometry, acoustic spectroscopy, and shear/oscillatory rheology. Results will be generated for crude oils and blends and model oil systems over a range of compositions and conditions.

**Sponsor:** Phillips 66

**PI/PD:** Clint Aichele, Peter Clark, Jim Smay, Alan Tree, Rob Whiteley

**Advanced Characterization of Hydrate and Emulsion Formation in Flowing Systems for Flow Assurance Applications**

This research addresses the petroleum industry’s need for strategies to mitigate hydrate formation in crude oil production systems. This project directly applies to multi-phase flow, rheology, fundamental particle behavior, and dynamic interfacial phenomena. Hydrate formation will be quantified both in emulsified systems and on pipe surfaces in flowing conditions using an inflow microscope. The thickness of hydrate layers and the rate of crystal growth on pipe surfaces will be quantified to elucidate hydrate attachment mechanisms to pipe walls for a variety of surfaces. These data will provide quantitative insight regarding the relationship between hydrate attachment and surface treatments on pipes.

**Sponsor:** American Chemical Society Petroleum Research Fund

**PI/PD:** Clint Aichele

**FRI De-entrainment Characterization**

Spray nozzles play key roles in chemical processing plants, yet, such nozzles have not been well studied. Their performances at large diameters and in hydrocarbons are seemingly difficult to predict. FRI and OSU jointly purchased a PDI from Artium Technologies. OSU investigators built an apparatus for the study of acid gas removal using aqueous amines in spray columns. That apparatus and PDI will be employed to study: small spray nozzles and the scale-up of data from small nozzles; deentrainment capabilities of various separator devices; and the utilization of deentrainment devices between distillation trays to improve tray performances at high rates.

**Sponsor:** Fractionation Research, Inc.

**PI/PDs:** Rob Whiteley, Clint Aichele

**CAREER: Multifunctional Polymer Coatings of Virus Particles for Safer and More Efficient Gene Delivery**

The study will investigate the effects of both PEG and PLL on overall gene delivery efficiency of a targeted polymer/adenovirus hybrid vector by exploring a library of grafted copolymers with varying polymer molecular weights and grafting ratios. The study also aims to better understand why some of the PEG-PLL copolymers perform better than others by elucidating the limiting step(s) in the gene delivery process. The investigator will study and compare the mechanisms by which the hybrid vectors and native adenovirus transform cells and compare the efficiency and rate at which the viral and hybrid vectors overcome barriers to gene delivery.

**Sponsor:** National Science Foundation

**PI/PD:** Josh Ramsey

**Nanocarrier-mediated Targeting of Bioscavengers to the Red Blood Cell for Prolonged Circulation and Projection**

Parenteral administration of butyrylcholinesterase (BChE) is effective against organophosphorus anticholinesterase (OP) toxicity but its efficacy is hampered by rapid clearance from circulation. Red blood cells (RBCs) have been used as a carrier for drugs, peptides and enzymes following external manipulations and subsequent reinfusion. The hypothesis is that cationic poly(l-lysine)-graft-poly(ethylene glycol) copolymer nanoparticles (NPs) containing both an antibody to the RBC membrane protein glycophorin A and a cell-penetrating peptide can deliver electrostatically encapsulated BChE molecules to the circulating RBCs in situ. Once bound to, or internalized into RBCs, the NPs will circulate for prolonged times providing long-term protection against OP challenge.

**Sponsor:** Defense Threat Reduction Agency

**PI/PDs:** Josh Ramsey

Center for Veterinary Health Sciences: Casey Pope

Division of Agricultural Sciences & Natural Resources: Steve Hartson

**Oklahoma Center for Respiratory and Infectious Diseases**

OSU is the lead institution of this multi-institutional research center. The center’s central theme is infectious diseases of the respiratory system with a focus on respiratory syncytial virus (RSV), influenza virus, and bacterial infections. Interdisciplinary projects cover disease pathogenesis, therapeutics, molecular mechanisms, and bioengineering. One aim of the center is to mentor junior investigators in becoming independent NIH-funded investigators and thus create a critical mass of multi-disciplinary investigators in respiratory infectious diseases. A second aim is to build up research infrastructure, and a third aim is to foster inter-institutional collaborations in Oklahoma by promoting scientific interactions through the center.

**Sponsor:** National Institutes of Health

**PI/PDs:** Heather Fahlenkamp

Arts & Sciences: Wendy Picking

Center for Veterinary Health Sciences: Lin Liu

**Shear Extrusion to Treat Fecal Waste**

During Phase I, it was confirmed that viscous heating and shear stress created by extrusion is effective for sanitizing fecal wastes. The PIs designed, built and operated a mechanical extruder that achieved 190°C repeatedly for a fecal simulant and destroyed 99% of parasite worm eggs in baboon feces near ambient temperatures. This continuing effort will evaluate this technology for the destruction of samples containing Ascaris. After modifying the equipment design, based on previous experimentation, the PIs will test pig fecal samples containing *Ascaris suum* at Oklahoma State University’s National Center for Veterinary Parisitology.

**Sponsor:** Bill & Melinda Gates Foundation

**PI/PDs:** Gary Foutch, A.J. Johannes, Jim Smay

**Surface and Airborne Monitoring Technology for Detecting Geologic Leakage in a CO2-Enhanced Oil Recovery Pilot, Anadarko Basin, Texas**

OSU, with the cooperation of the Southwest Regional Carbon Sequestration Partnership (SWP), will develop and implement new near-surface and airborne monitoring technologies. The research will focus on the design and deployment of a dense grid of shallow subsurface and surface sensors in combination with low-altitude airborne detection of CO2and CH4. These technologies will be deployed in the Farnsworth Oil Unit in the Anadarko Basin of the northeastern Texas panhandle, where the SWP and Chaparral Energy, LLC, are conducting CO2-enhanced oil recovery experiments.

**Sponsor:** Department of Energy

**PI/PDs:** Peter Clark

Civil & Environmental Engineering: Tyler Ley

Mechanical & Aerospace Engineering: Jamey Jacob, Girish Chowdhary

College of Arts & Sciences: Jack Pashin, Nicholas Materer

**Petrophysics and Tight Rock Characterization for the Application of Improved Simulation and Production Technology in Shale**

This research program is designed to improve understanding of how stimulation fluids and additives interact with shale matrix. Achieving this goal requires a fundamental understanding of petrology, petrophysics, and fluid-rock interactions. The proposed research is important for identifying ways to minimize formation damage caused by fracturing fluids, improving the effectiveness of hydraulic fracturing, and decreasing the need for refracturing. Identifying best practices and proposing standards for petrophysical analyses will help ensure the reproducibility of laboratory results and will increase the reliability and efficiency of hydrofracturing operations.

**Sponsor:** Research Partnership to Secure Energy for America (RPSEA) for Dept. of Energy

**PI/PDs:** Peter Clark, Khaled Gasem, Sayeed Mohammad

Arts & Sciences: Jim Puckette, Jeff White

**Multi-Scale Fouling Characterization of Fermented/Hydrolyzed Sweet Sorghum**

Biofuel process streams are fouling intensive fluids that carry biological agents, dissolved solids, biomass, and other proteinaceous substances. Very little information is available about the fouling mechanisms of these fluids on either a laboratory or industrial production scale. This project will focus on the fouling characteristics of fermented sweet sorghum. The goal of the project is to develop a fundamental and applied understanding of the fouling characteristics of fermented/hydrolyzed sweet sorghum in bioethanol recovery equipment.

**Sponsor:** South Central Sun Grant Program for U.S. Dept. of Transportation

**PI/PD:** Rob Whiteley

**Spray Characterization Equipment**

This project consists of characterizing sprays using a Phase Doppler Interferometer. Fractionation Research Incorporated (FRI) will contribute toward the purchase of the instrument. The instrument will support several fundamental and applied research projects at Oklahoma State University and FRI. Through the use of solid state lasers, the instrument has the ability to resolve a wide range in droplet diameter (0.5 µm – 2 mm). In addition, the instrument measures droplet velocity. Through the characterization of both droplet size and velocity, the measurements will provide insight to both fundamental and applied applications of spray phenomena.

**Sponsor:** Fractionation Research, Inc.

**PI/PDs:** Clint Aichele, Rob Whiteley

**CAREER: An Advanced 3D Tissue Model for the Detection and Study of an Allergic Inflammatory Response**

This NSF CAREER development plan seeks to use an advanced 3D tissue model to investigate the key aspects of an allergic inflammatory response, more specifically the cellular components at the site of inflammation and mediators, such as growth factors, chemokines, cytokines, and extracellular matrix components that regulate inflammation. The proposed transdisciplinary research will be complimented by the PI’s education plan, which will integrate science and engineering research into curriculum at high school, undergraduate, and graduate levels.

**Sponsor:** National Science Foundation

**PI/PD:** Heather Fahlenkamp

**Optimum Injectable Hydrogels for Cartilage Regeneration**

The objective is to test developing an injectable hydrogel formulation mimicking cartilage architecture and use skin fibroblasts or MSCs to regenerate cartilage. The underlying hypothesis is that developing biologically inspired scaffolds mimicking the *in vivo* environment will serve as permissive substrate for cell growth, differentiation, and biological function of a cell. To test the hypothesis, the investigator will use injectable hydrogels formed using a chitosan-gelatin-hyaluronic acid (HA) mixture and test the effect on cells derived from two different lineages: fibroblasts, and MSCs.

**Sponsor:** Oklahoma Center for the Advancement of Science and Technology

**PI/PD:** Sundar V. Madihally

**Ethics for Researchers: Helping Moral People Act Ethically**

Standard Research Ethics classes neglect the topic of *moral psychology*. Specifically, these classes do not teach students *why* people act unethically, and they do not provide students with strategies that they can use in order to increase the likelihood that they will act in accord with their own ethical commitments and/or the ethical codes of their professions. The goal of this proposal is to develop a class, Ethics for Researchers: Helping Moral People Act Ethically, which will meet this need.

**Sponsor:** National Science Foundation

**PI/PDs:** Martin S. High

Arts & Sciences: Scott Gelfand, Shelia Kennison

Education: R. Steven Harrist

**Center for Interfacial Reaction Engineering**

Knowledge of the phase behavior and the thermophysical properties of organic mixtures encountered in biomass and petroleum conversion processes is essential to the proper design, operation and optimization of such processes. The project will build upon the research team’s previous work in order to further develop theory-framed, structure-based phase behavior models for biphasic catalytic systems and identify improved organic solvents to optimize product separation in these systems. Completion of this research will provide the required modeling capability to develop effective bi-phasic catalytic processes for upgrading and refining of complex feed stocks including bio-oils.

**Sponsor:** University of Oklahoma for Department of Energy

**PI/PDs:** Brian Neely, Clint Aichele

Arts and Sciences: J. White

**Civil and Environmental Engineering**

**Comparative Assessment of the Current Gross and Axle Truck Weight and Truck Permitting Laws in the United States and a Theoretical Analysis of the Infrastructure Impacts of Weight Exceptions that Allow Loads in Excess of the Gross and Axle Weight Limits Established by the Bridge Formula and the National Single Axle, Tandem Axle and Total Gross Vehicle Weight Limits**

The ODOT Senior Staff requires information regarding the impact of the increase in legal load limits on the Oklahoma Highway Infrastructure. Chief among their concerns are the impact of increased truck weight limits on the existing highway infrastructure, and what the costs to new projects, rehabilitation projects, and maintenance will be. There are also questions about what policies are in force in the contiguous United States with particular emphasis on the states adjacent to Oklahoma. The proposed investigation will respond to the needs of the ODOT Senior Staff by providing key answers to these questions.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PDs:** Bruce Russell, Xiaoming Yang, Joshua Li, Kelvin Wang

Technology: Rachel Mosier

University of Oklahoma: Jeffrey Volz, Dominique Pittenger

University of Tulsa: Jeremy Daily

**Shrinkage Induced Deformation in Steel Bridges Made Composite with Concrete Deck Slabs – Phase 2**

The Phase 2 and 3 goals are to further investigate the phenomena of concrete shrinkage and other volume changes, and to assess their effects on deflections in steel bridges made composite with concrete decks. Tasks include: 1) Construct a full-sized bridge prototype that mirrors construction in ODOT bridges and a test setup for evaluating typical forming systems, 3) Make recommendations to improve forming and bracing systems supporting fresh concrete, 4) Perform temperature loading on the bridge deck, 5) Perform repeated load testing on the prototype bridges. 6) Perform testing including measurements for compressive strength, tensile strength, elastic modulus and shrinkage.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PDs:** Bruce Russell, Tyler Ley

**One Voice for Sewer Infrastructure**

*One-Voice* is an initiative to develop and publically present empirical data that accurately demonstrates the condition and trends for underground sewer infrastructure across the U.S. The project will provide the National Association of Sewer Service Companies (NASSCO) with information on which to base a decision of whether to proceed with the One Voice initiative. The deliverable will be a report that establishes costs of developing and sustaining this initiative compared to industry-wide and NASSCO specific benefits. The outcome will be a determination of the efficacy of the *One-Voice* database and the feasibility of expanding the prototype on a national level.

**Sponsor:** NASSCO, Inc.

**PI/PDs:** Phil Lewis, Yongwei Shan

**SPTC Internship - Waylink**

The 2015 TRIP program is focused on summer internships for students seeking to gain valuable professional experience through working for a transportation related company or a government organization/agency such as a department of transportation over a period of 10 to 12 weeks. OSU on behalf of the Southern Plains Transportation Center funded a portion of the stipends, while the employer provided a portion of the stipends. This award provided summer internships with Waylink.

**Sponsor:** University of Oklahoma for the Southern Plains Transportation Center for the Oklahoma Department of Transportation SPR

**PI/PD:** John Veenstra

**3D Laser Imaging Based Real Time Pavement Surface Evaluation for High Friction Surfacing Treatments (HFST)**

State-of-the-art PaveVision3D technology will be used to better quantify the surface characteristics of High Friction Surfacing Treatments (HFST) demonstration sites in 11 states. The goal is to better quantify the surface characteristics of installed HFST after a period of traffic operation. Updated software will be developed for the data integration.

**Sponsor:** The Transtec Group, Inc. for the Federal Highway Administration

**PI/PDs:** Joshua Li, Kelvin Wang

**Evaluation of Ec3000 as Stabilizer to Reduce Risk on Design-Build Pavement Projects in Texas Constructed on Expansive Soils**

As a subcontractor, OSU’s scope of work for the project involves: 1) Suction measurements (including osmotic suction) using different concentrations of Ec3000 in different soil types, 2) Determination of the soil-water characteristic curve (SWCC) for the selected soil types, 3) Perform moisture diffusion tests to establish diffusion coefficients for the soils, 4) Measuring soil index properties, 5) Field testing and monitoring, 6) Assisting in developing and conducting other laboratory tests and field tests as needed for the successful completion of the project.

**Sponsor:** Texas A&M Transportation Institute for Environmental Soil Stabilization, LLC

**PI/PD:** Rifat Bulut

**Safety Analysis Opportunities Using Pavement Surface Characterization Based on 3D Laser Imaging**

This project addresses critical needs in the testing and validation of new emerging 3D laser imaging technology for multiple safety and pavement evaluation purposes. In the project, the 3D laser imaging technology will cover the complete highway lane at 1mm or higher resolution in all three dimensions at the data collection speed of 60MPH. The potential being investigated is the use of the 3D laser imaging technology as a one-pass data collection device for many different data needs for pavement engineering. Phase 1 covers: crash reduction potential, cost/benefit and multiple uses, geometric data correction for virtual pavement, and validation.

**Sponsor:** Federal Highway Administration

**PI/PDs:** Kelvin Wang, Joshua Li

**Development of an Asphalt Pavement Test Facility at the OSU Unmanned Aerial Vehicle Facility**

The objective is to assist in the construction of the UAV runway to develop a pavement that can be used as a test facility for evaluation of pavement materials including, but not limited to, plant-mixed warm and hot mix asphalt pavements, high RAP and RAS mixes, asphalt surface treatments, pavement preservation treatments, 100% RAP cold mixes and aggregate bases with surface treatments. At the completion of the construction, ODOT will have a facility available to them through OSU to test and evaluate surface treatments, surface mixes, including high RAP and RAS mixtures, and pavement preservation treatments for various applications.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PDs:** Stephen Cross, Joshua Li, Kelvin Wang

**The Use of Resistivity Testing for Quality Control of Concrete Mixtures**

The objective of this project is to investigate the potential of resistivity testing in assessing the performance of typical concrete mixtures used in bridge and pavement infrastructure in Oklahoma. The sensitivity and reliability of the method with Oklahoma materials will be investigated in order to formulate new guidelines and specifications that would allow ODOT to produce high quality concrete. These specifications could be used to approve and accept concrete mixtures. This means that strength would no longer be the only value that is used to accept a concrete mixture and instead a measurement of permeability could be included.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PDs:** Julie Ann Hartell, Tyler Ley

**Sustainability and Training Materials for In-Place Recycling**

Studies have shown in-place recycling to be a sustainable, cost-effective procedure for rehabilitation of hot mix asphalt pavements. The intent of this project is to develop a sustainability calculator that will document the sustainability benefits of in-place recycling compared to traditional maintenance and rehabilitation techniques and to develop interactive training materials that will serve as a Basic Recycling Primer for in-place recycling. The sustainability calculator will be made available for local agencies and the training materials developed will be provided to the Transportation Curriculum Coordination Council, which will develop an interactive web based training course.

**Sponsor:** University of Oklahoma for the Southern Plains Transportation Center for US Department of Transportation, Asphalt Recycling & Reclaiming Association

**PI/PDs:** Phil Lewis, Stephen Cross

**Alternative Cementitious Materials for Development of the Next Generation of Sustainable Transportation Infrastructure**

As part of a collaboration with Georgia Tech on a Federal Highway Administration project, OSU is responsible for completing freeze thaw durability testing of the materials, mCT and mXRF scans of laboratory and field based samples to investigate deterioration, and surveys of several different sites where ACMs have been used to evaluate their performance. Samples will be taken from these sites and evaluated with mCT and mXRF as needed.

**Sponsor:** Georgia Institute of Technology for Federal Highway Administration

**PI/PDs:** Tyler Ley, Paul Tikalsky

**Monitoring Extreme Loading and Climate Impact on Infrastructure**

To address climate impact and traffic overload on concrete infrastructure, evaluation and monitoring guidelines will be developed using sensing technologies such as acoustic emission monitoring capable of qualifying and quantifying material damage and locating zones in distress. Climatological profiles will be created for critical infrastructure regions of Oklahoma using climatological data from *Oklahoma Mesonet*. The effects of exposure combinations on concrete properties will be continuously monitored and analyzed using AE and ultrasonic techniques. Signature wave parameters that may be characteristic of temperature change, moisture change or microstructural changes will be determined and implemented towards the creation of new monitoring guidelines.

**Sponsor:** University of Oklahoma for the Southern Plains Transportation Center for Oklahoma Department of Transportation

**PI/PDs:** Julie Hartell, Phil Lewis, Tyler Ley, Yongwei Shan

**Safety Evaluation of Pavement Surface Characteristics with 1mm 3D Laser Imaging**

Accurate and timely information on pavement surface characteristics are critical for evaluating the performance, condition, safety, and serviceability of pavements of streets, roadway, and airfields. Even though high-speed technologies to gather information on pavement macro-texture, friction, and profiles are mature, separate instrumentation is needed for each of these data collections. Further, surveys of longitudinal and transverse profiles and macro-texture can only be conducted on a limited small area on a pavement lane, or line-of-sight. This research focuses on the application of 1 mm 3D imaging with full-lane coverage at highway data collection speed for various safety evaluations.

**Sponsor:** University of Oklahoma for the Southern Plains Transportation Center for the US Department of Transportation

**PI/PD:** Kelvin Wang

**Development of Mixture Designs for Pumpable Concrete for Extreme Weather**

Recent research has aimed to improve optimized graded concrete specifications for slip formed paving concrete. Preliminary estimates found that cost savings of over $4 million and energy to power over 400 homes could be saved each year that the specification is used in Oklahoma. Oklahoma DOT was so excited about this work that they decided to provide additional funding to extend these findings to structural concrete. Funding from this grant will be used to extend the current research to a larger number of materials and to also focus on the performance of these materials in extreme environments.

**Sponsor:** University of Oklahoma for the Southern Plains Transportation Center for the US Department of Transportation

**PI/PDs:** Tyler Ley

**Use of a Novel Controlled Release Surface Curing Agent for Bridge Decks**

The project involves a novel curing technique that can be rapidly applied to the surface of fresh concrete and not cause deformations in the concrete surface. The research is expected to show that the material has equal or better curing performance than typical wet curing methods and is sustainable and safe for the environment. Project objectives include: 1) Develop a field application method for the novel curing material; 2) Develop specifications for the quality control and usage of the novel curing material; 3) Work with contractors in Oklahoma to implement this technology in the field and evaluate the effectiveness.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PDs:** Tyler Ley, Kelvin Wang, Julie Ann Hartell

**Development and Implementation of a Mechanistic and Empirical Pavement Design Guide (MEPDG) for Rigid Pavements: Phase 3**

The Mechanistic-Empirical Pavement Design Guide (MEPDG) is the new pavement design guide released by the American Association of State Highway and Transportation Officials (AASHTO). AASHTO suggests that each state highway agency validate and, if necessary, calibrate the MEPDG design models based on local conditions. The objective of the research is to validate and calibrate the MEPDG for the design of typical Oklahoma rigid pavements. The secondary objectives of the research are: 1) to continue to monitor the field performance of the instrumented road section on I-44 and 2) to investigate the slab/base friction property of typical Oklahoma rigid pavement structures.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PD:** Xiaoming Yang, Tyler Ley

**Assessing Time to Deficiency for Highway Bridge Superstructures – Phase 2**

The overall goal of the study is to compare the time it takes for pre-stressed concrete and steel bridge superstructures to be rated as deficient in twelve states from different regions of the United States. In order to meet this goal, the following research objectives will be pursued: 1) Evaluate time to deficiency for each bridge type, and 2) Develop time to deficiency models for each bridge type.

**Sponsor:** American Institute of Steel Construction LLC

**PI/PD:** Phil Lewis

**Improving Specification to Resist Frost Damage in Modern Concrete Mixtures**

Objectives include: 1) Determine the necessary properties of the air-void system to provide satisfactory frost durability in laboratory testing of laboratory and field concretes with different combinations of admixtures, cements, and mixing temperatures in salt environments; 2) Determine the accuracy of a field test method that measures air void system quality with field and laboratory concrete; 3) Determine critical combinations of absorption and the critical degree of saturation on the frost durability in accelerated laboratory testing in the presence of deicer salts; 4) Establish test methods and specifications for fresh and hardened concrete to determine frost durability and field performance.

**Sponsor:** Oklahoma Department of Transportation for FHWA SPR Pooled Funds, Ready Mixed Concrete Research & Education Foundation

**PI/PD:** Tyler Ley

**Characterizing the Impact of Prefabrication on Productivity in Building Electrical Construction**

The goal is to establish a series of rigorous metrics, data collecting procedures, and analysis techniques for both construction practitioners and owners in order to measure and estimate the impact of prefabrication on productivity in electrical trades. This research will use a traditional productivity study as well as activity analysis techniques. This research presents a novel way of using a Building Information Modeling-based simulation approach to estimate the potential of prefabrication in electrical productivity improvement during a project’s planning and design stage. The outcome will be an understanding of the potential productivity impact of electrical prefabrication systems in building construction.

**Sponsor:** ELECTRI International

**PI/PDs:** Phil Lewis, Yongwei Shan

**Determining the Long Term Performance of Petroleum Storage Tank Foundations through the Use of Case Studies**

The aim is to build a database of past tank foundation performance that can be interrogated to determine the successful characterization of varying types of foundations and double bottom repairs in different environments. The team proposes to use owner inventory, construction and inspection records of tank foundations in combination with historical weather and soil information, and geotechnical reports for the existing foundations and combine this information into a single database. This database can be investigated to determine which foundations perform best in different situations. Another focus will be to determine the expected life of a double bottom tank foundation repair.

**Sponsor:** American Petroleum Institute, International Liquid Terminals Association

**PI/PDs:** Tyler Ley

Division of Agricultural Sciences and Natural Resources:Wade Brorsen

**Investigating the Solubility and Reactivity of Fly Ash**

Research will be conducted to determine the fly ash characteristics that have the greatest impact on its interactions with cement during early-age hydration. Several methods will be used to monitor aspects of the reactivity of various fly ashes alone and when mixed with Portland cement. This approach will establish structure-processing-property relationships that will be used to pinpoint the materials characteristics that most dramatically influence retardation and delayed setting in these systems. This will be crucial to designing improved specifications for fly ash materials and for developing test methods used to assure the early-age performance of high-volume fly ash concrete.

**Sponsor:** U.S. Dept. of Commerce – National Institute of Standards and Technology

**PI/PD:** Tyler Ley

**Biosand Methods for Drinking Water**

The project will develop methods for optimizing the process required for constructing and operating biosand water filters. Experiments will be conducted at OSU and tested in Honduras. The research will support efforts of a pilot facility, currently employing two people and building two filters per week. If successful, this work will speed up the production process without compromising the efficacy of the filters, allowing the facility to construct at least ten filters a day. It will also allow for better operations of the filters. These results can easily translate to other biosand operations working with limited resources in developing countries.

**Sponsor:** U.S. Environmental Protection Agency

**PI/PD:** Greg Wilber

**SusChEM: Collaborative Research: A Multi-Scale Environmental and Kinetics Study on the Pyrolysis of Sustainable Biomass Feedstock**

This collaborative study between Tennessee Technological University and OSU looks at the kinetics and socio-economic broader impacts of biomass pyrolysis. The investigators will introduce a Multiple Variable Control Volume Reactor to independently control the particle-related and homogenous-related transport phenomena and associated reactions, making it possible to independently observe the two processes. In a serious of experiments, model compounds and whole biomass will be studied in an effort to understand the extent to which pyrolysis occurs within condensed phase intermediates and the homogeneous gas phase. The PIs will also introduce a new multi-scale modeling platform based on kinetic cellular automaton.

**Sponsor:** National Science Foundation

**PI/PD:** Tyler Ley

**Surface Characteristics with 3D Data and Improved Airport PCI Survey Solutions**

The project includes two technological developments that will provide the National Airport Pavement Test Facility with innovative tools to evaluate surface characteristics of Construction Cycles and airport pavements, and to improve airport condition survey efficiency via Pavement Condition Index. The research team will produce a white paper detailing use of new 3D imaging techniques to conduct surveys of relevant airfield pavement surface characteristics. Software modules for macro-texturing and grooving analysis will be developed as part of the updated ProGroove software. 3D pavement surface imaging data and innovative software algorithms will be used to expedite data processing for Pavement Condition Index.

**Sponsor:** Federal Aviation Administration

**PI/PD:** Kelvin Wang

**Southern Plains Transportation Center**

OSU is a subrecipient of the Southern Plains Transportation Center, a Regional University Transportation Center headquartered at the University of Oklahoma. OSU will conduct three research projects funded with the 2013 Regional UTC grant: embedded MEMS sensor system in pavement materials; precast concrete slabs for pavements; 3D 1mm imaging for automated assessment of pavement surfaces. In addition, OSU will conduct education and workforce development activities within the theme of the 2013 Regional UTC proposal.

**Sponsor:** University of Oklahoma for Southern Plains Transportation Center for U.S. Department of Transportation

**PI/PD:** Kelvin Wang

**Development of a Prototype Geotechnical Report Database**

The ODOT geotechnical branch has scanned and stored reports in portable document format (PDF) since 2007, however, scanning and cataloging is time consuming and labor intensive. There is a need to develop a new system to allow easy data archiving and instant data access by searching the key information. The objective is to develop a proof-of-concept geotechnical report database that best fits the needs of the ODOT geotechnical branch. At a minimum, the system will feature data stemming from in-house archived files, in-house files currently being recorded in a quasi-automated recall-system, and data provided to the department via contract services.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PDs:** Xiaoming Yang, Rifat Bulut

**Expected Life of Silane Water Repellant Treatments on Bridge Decks – Phase II**

In phase 1, laboratory and field techniques showed that silanes appear to have an effective lifespan between six and nine years. In Phase 2, the team will investigate the use of a new coating system that is a combination of silane and flood coat on existing bridges. They will also increase the number of samples taken from bridges that have been in service between 5 and 15 years to investigate silane performance, as well as further investigate concrete that has shown satisfactory silane performance in the field for extended periods of time.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PD:** Tyler Ley

**Investigation of Optimized Graded Concrete for Oklahoma – Phase 2**

Phase 1 focused on using optimized graded concrete for pavements and resulted in a new optimized graded specification for Oklahoma. Phase 2 will apply lessons learned to the usage of optimized graded concrete for structures. Tasks include: Develop tests to evaluate constructability of optimized graded concrete for structures; Complete testing to determine limits for the variation of aggregate gradations and changes needed in the current ODOT specification; Work with contractors to produce optimized graded concrete for structures to determine field performance; Produce specifications, design protocols and pay factors to ensure high quality optimized graded concrete is produced for Oklahoma’s structures.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PDs:** Tyler Ley, Bruce Russell

**Shrinkage Induced Deformation in Steel Bridges Made Composite with Concrete Deck Slabs**

Some of Oklahoma’s re-constructed bridges have experienced decks deflecting downward more than projections anticipated. One suggestion is that the excessive deflections were caused by drying shrinkage of concrete. Other considerations could include errors in design, errors in the computation of deflections, or unexpected deformations of the forms, framing systems, or screed rails that supported the bridge decks during casting. Project objectives are to identify the causes for the excessive deflections in steel girder bridges made composite with concrete deck slabs and to develop design and construction method recommendations that will mitigate future problems associated with excessive deflections in these bridges.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PDs:** Bruce Russell, Tyler Ley

**Energy Dissipation in Thirty-foot Broken-Back Culverts Using Laboratory Models**

This project will investigate a vertical drop of 30 feet that may result in effective energy dissipation and consequently minimum scour downstream of broken-back culverts. Findings will be directly applicable in the design of broken-back culverts to be retrofitted or reconstructed in the field. A survey of existing broken-back culverts indicates that a range of culverts exists from 6 to 30 feet. This project represents a continuation of four previous projects in which 6, 12, 18, and 24 foot drops were studied. This project will study dissipation efficiency and appurtenances design for 30 foot drops using laboratory scale modeling techniques.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PD:** Avdhesh K. Tyagi

**Surface and Airborne Monitoring Technology for Detecting Geologic Leakage in a CO2-Enhanced Oil Recovery Pilot, Anadarko Basin, Texas**

OSU, with the cooperation of the Southwest Regional Carbon Sequestration Partnership (SWP), will develop and implement new near-surface and airborne monitoring technologies. The research will focus on the design and deployment of a dense grid of shallow subsurface and surface sensors in combination with low-altitude airborne detection of CO2and CH4. These technologies will be deployed in the Farnsworth Oil Unit in the Anadarko Basin of the northeastern Texas panhandle, where the SWP and Chaparral Energy, LLC, are conducting CO2-enhanced oil recovery experiments.

**Sponsor:** Department of Energy

**PI/PDs:** Tyler Ley

Chemical Engineering: Peter Clark

MAE: Jamey Jacob, Girish Chowdhary

College of Arts & Sciences: Jack Pashin, Nicholas Materer

**Biology and Engineering for a Sustainable Tomorrow**

This program is part of the Oklahoma State Regents for Higher Education’s Summer Academies for Mathematics, Science, & Multidisciplinary Studies. The program will introduce the importance of biology and engineering in everyday life and will expose students to the future technologies that exist at their interface. Students will participate in design and experimentation involving critical issues that rely on both science and engineering, including water quality, renewable energy development, ecosystem balance, and environmental remediation. The academy will host 50 students per year at Oklahoma State University during two different summer sessions.

**Sponsor:** Oklahoma State Regents for Higher Education

**PI/PDs:** Gregory G. Wilber

Division of Agricultural Sciences & Natural Resources: Danielle Bellmer

**Collaborative Research: Coupling System Chemistry and Time-Dependent Deformation of Cementitious Materials through Evolving Thermodynamic States**

The primary objective of this project is to develop a fundamental thermodynamic model framework that links evolving system chemistry and mechanics of cementitious materials, and to implement the model through a computational method that predicts the fully coupled evolution of microstructure and viscoelastic/viscoplastic properties of the materials. Any stress induced changes to the material microstructure – and resulting time-dependent deformation – will be predicted by the model. In synergy with the fundamental modeling, novel experiments utilizing time-stepping micro-computed tomography of stressed specimens will be performed to verify and quantify the interconnection between chemistry and mechanics through phase dissolution in cementitious materials.

**Sponsor:** National Science Foundation

**PI/PD:** Tyler Ley

**Pavement Condition Survey Evaluation for UT Austin**

The OSU team will drive the data collection vehicle to areas near Austin, Texas to collect pavement condition data in 3D at the beginning of the project. The data will be processed by the OSU team and the results, per TxDOT and UT requirements, will be submitted to the UT Austin team within the project timeframe.

**Sponsor:** University of Texas for the Texas Department of Transportation

**PI/PD:** Kelvin Wang

**The Effects of Soil Suction on Shallow Slope Stability**

The study will involve laboratory testing of soil suction and unsaturated soil moisture diffusivity coefficient measurements. The team will collect soil specimens with the help of ODOT personnel from sites where shallow landslides have already occurred. The research team in collaboration with ODOT engineers will decide on the number of tests for suction and diffusion parameter measurements. The Shelby tube size soil specimens will be sampled from the sites and wrapped against any moisture loss or gain, and will be delivered to laboratory for testing. The OSU team will help OU researchers conduct field investigations, soil sampling, and data analysis.

**Sponsor:** University of Oklahoma for the Oklahoma Transportation Center for the Oklahoma Dept. of Transportation for the Federal Highway Administration

**PI/PD:** Rifat Bulut

**Data Preparation for Implementing DARWin-ME**

The primary objective of the study is to establish a workflow for the Arkansas State Highway & Transportation Department (AHTD) to start implementing DARWin-ME for production and to develop relevant technologies so that positive impacts of DARWin-ME will be fully exploited in pavement design, management, materials, construction, and traffic data collection. The long-term impact of this and other follow-up studies will be the establishment of a database infrastructure to support the entire pavement engineering activities of AHTD including traffic, materials, construction, pavement management, and others.

**Sponsor:** University of Arkansas for the Arkansas State Highway and Transportation Department

**PI/PD:** Kelvin Wang

**Development and Implementation of a Mechanistic and Empirical Pavement Design Guide (MEPDG) for Rigid Pavements – Phase II**

There are great advantages in the design of infrastructure if the design procedures are based on mechanisms and variables that determine the performance of the element in service. The Oklahoma Department of Transportation (ODOT) is investigating implementation of the mechanistic and empirical pavement design guide MEPDG to accomplish this, but the designs would benefit from using material inputs that are typical of those used in ODOT construction projects. This project will help determine inputs for the MEPDG that are representative of Oklahoma materials, construction methods, and weather. This will improve the economy, durability and performance of rigid pavements in Oklahoma.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PD:** Tyler Ley

**3D Laser Imaging for ODOT Interstate Network at True 1-mm Resolution**

With 3D image data representing actual pavement surface, it is possible to create a true representation of pavement surface at 1mm resolution to be used as input data for various condition evaluations and safety analysis. Objectives are 1) generating geographically true and complete virtual pavement surfaces with an Inertial Measurement Unit at 1mm resolution for the ODOT *interstate* network and SH 51 from I-35 to Sand Springs, 2) providing solutions for automated evaluation of pavement surface including cracking, rutting, faulting, and pavement macro-texture, cross-slope, and roadway geometric data, 3) providing workstation with monitors and software programs for providing the solutions.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PDs:** Kelvin Wang, Tyler Ley

**Mechanisms of Hydration and Setting of Ordinary Portland Cement in Simple and Complex Systems**

For this proposal OSU will be responsible for completing laboratory scale micro X-ray computed tomography (mCT), focused beam X-ray Fluorescence (mXRF), and focused beam X-ray diffraction (mXRD) on Portland cement and combinations of Portland cement with mineral and chemical admixtures. In addition, several tests will be completed with these same techniques at synchrotrons facilities. The experiments will focus on investigating the change in the hydration of different clinker phases in different soak solutions that simulate the pore solution chemistry of hydrating Portland cement.

**Sponsor:** Trustees of Princeton University for the Federal Highway Administration

**PI/PDs:** Tyler Ley

Mechanical and Aerospace Engineering: Jay C. Hanan

**CAREER: Increasing the Effectiveness of Mineral Additives in Concrete through Novel Particle Characterization**

The aims of this project are 1) develop a strong research program focused on increasing the use of supplementary cementitious materials (SCMs) as construction binders in concrete through new levels of chemical characterization, 2) involve underrepresented undergraduates in research and mentoring, and 3) increase awareness of science and engineering by underrepresented elementary students in low income schools.

**Sponsor:** National Science Foundation

**PI/PD:** Tyler Ley

**Traffic and Data Preparation for AASHTO Darwin-ME Analysis and Design**

The objective of the Prep-ME software is to assist state DOTs in the data preparation and improve the management and workflow of the DARWin-ME input data to make the DARWin-ME software more accessible, and input data sets of high quality. Additionally, it can be used as a tool for calibrating and implementing the DARWin-ME. For production use, the Prep-ME software in its current form needs to be enhanced to improve speed, usability, functionality and stability. The team will take advantage of four years’ experience working with the MEPDG and Prep-ME to efficiently implement necessary enhancements for the DARWin-ME software program.

**Sponsor:** Louisiana Transportation Research Center for the Louisiana Dept. of Transportation

**PI/PD:** Kelvin Wang

**Safety Culture of the US Transit Industry**

The objective of the proposed work is to assist the FTA’s Office of Transit Safety and Security in assessing and enhancing the existing safety culture of transit agencies. The anticipated results include presentations in technical conferences and a survey of the safety culture of transit agencies.

**Sponsor:** University of Oklahoma for the Federal Transit Administration

**PI/PD:** M.S. Ahmed

**Electrical and Computer Engineering**

**Memorandum of Understanding with Tinker AFB**

This is a Memorandum of Understanding between the 76th High Performance Computing Center (HPCC) at Tinker Air Force Base and OSU. The HPCC conducts research and provides innovative technologies and implementation to the Oklahoma City Air Logistics Center. The HPCC is leveraging academia and research in the area to collaborate on cutting-edge technology and methodologies. This MOU establishes collaboration standards between the HPCC and OSU for the development of radar modeling concepts and applications.

**Sponsor**: Department of the Air Force, Tinker Air Force Base

**PI/PD:** James West

**Rational Design of Thermoelectric Materials and Material Processing Approaches Based on Microwave Processing of Silicides**

Dr. Krasinski will work on the construction of the pulsed high voltage power supply for the pulsed magnetron. He will design the electronic circuit and work closely with Dr. Vashaee on building the pulsed microwave source. He will also perform the experiments investigating the effect of the E and H field in the decrystallization process. The work at OSU will occur in direct coordination with NCSU where the ultimate materials systems will be devised.

**Sponsor**: North Carolina State University for the National Science Foundation

**PI/PD:** Jerzy Krasinski

**TC: Small: Collaborative Research: Exploring a Robust Quantum Cryptography Protocol for Securing Optical Burst Switching Networks**

This project explores a robust quantum cryptography protocol for securing optical burst switching (OBS) networks, providing a means to make the OBS-based future Internet trustworthy from the ground up. Since the OBS network has a one-to-one correspondence between the header and its associated burst, the same relationship can be exploited for encryption. The quantum-based methodology makes it possible to distribute keys securely so that each burst is encrypted and decrypted with a unique key.

**Sponsor**: National Science Foundation

**PI/PDs:** Subhash Kak

University of Oklahoma: Pramode Verma

University of Houston: Yuhua Chen

**NRI: Considerate Co-robot Intelligence through Ubiquitous Human State Awareness**

The objective is to develop a new theoretical/algorithmic framework and an open hardware/software platform for considerate co-robot intelligence, enabling a co-robot to assist humans in their daily lives in a proactive way while still having the freedom to do its routine work. The research consists of four parts: co-robot semantic mapping through human environment interaction; human activity and location inference using minimal motion sensor data; activity prediction and behavioral anomaly detection based on human state awareness; experimental evaluation using open hardware/software platforms and a case study evaluating the effectiveness of considerate co-robot intelligence in elderly fall prevention, detection and intervention.

**Sponsor**: National Science Foundation

**PI/PDs:** Weihua Sheng, Guoliang Fan

**Dual Mode Ultrasound-Imageable Thermosensitive Liposomes for Image-Guided Therapy**

This project will meet challenges in prostate cancer chemotherapy through a dual-mode Low Temperature Sensitive Liposome (DML) that will co-encapsulate both Docetaxel (therapeutic agent) and an echogenic ultrasound contrast agent to permit image-guided drug delivery (IGDD)-based therapy. The development of DML and its combination with ultrasound mediated IGDD is attractive for its relative simplicity, cost-effectiveness, speed of ultrasound image acquisition, and ability to permeabilize cell membrane and enhance drug extravasations in tumor; all of which can dramatically improve therapeutic success. This approach will be a milestone for providing real-time control of IGDD, administering synergistic treatment, and prevention of tumor recurrence.

**Sponsor**: Oklahoma Center for the Advancement of Science and Technology

**PI/PDs:** Daqing Piao

Center for Veterinary Health Sciences: Ashish Ranjan

**Rational Design of Thermoelectric Materials and Material Processing Approaches Based on Microwave Processing of Silicides**

This research plan addresses the essential need for a physical description of charge and phonon transport in amorphous materials, characterization of their structural dependencies, and application of this understanding to enhance the thermoelectric performance of amorphous and the more complex structure of amorphous–crystalline composite materials. The proposed program is a computationally guided material design which encompasses both theoretical and experimental aspects of amorphous based materials. As such, a significant part of the research will be devoted to theoretical calculations and modeling.

**Sponsor:** National Science Foundation

**PI/PDs:** Daryoosh Vashaee, Jerzy Krasinski

Materials Science and Engineering: Lobat Tayebi

**Development of High Efficiency Nanostructured Thermoelectric Generators for Industrial Waste Heat Recovery**

Over the past six years, the investigators have developed advanced nanostructured thermoelectric materials at lab scale that can work efficiently for applications from room temperature to 1100 C. The purpose of this OCAST accelerated research program is to scale up the method of synthesis of such efficient material structures and package them to form thermoelectric generators that can be employed at different locations appropriate for industrial applications. OSU will lead the material research and innovation. Marlow Industries will lead the packaging of the thermoelectric modules, and Amethyst Research Inc. will lead the hydrogenation optimization and commercialization steps.

**Sponsor:** Oklahoma Center for the Advancement of Science and Technology

**PI/PD:** Jerzy Krasinski

**Secure High Performance Multi-Core Computer Architecture Design and Exploration**

The goal is to research and develop high-level synthesis tools for SoC platforms in nanometer CMOS technologies that: 1) provide ability to efficiently integrate embedded memories, low-power/high-performance circuits and processors, mixed-signal designs, and communication structures, 2) combine synthesis and layout information to accurately estimate area, delay, and power from high-level SoC architecture descriptions, 3) facilitate rapid design-space exploration of secure SoC solutions, and 4) are well documented, easy to use, and publicly available for AFRL personnel. It is anticipated that project outcomes will aid in development and deployment of silicon architectures for any division that employs trusted foundry fabrication capabilities.

**Sponsor:** United States Air Force

**PI/PD:** James Stine

**Development of an endoscopic position-sensitive beta-radiation-detection system toward in situ positron emission topography for bladder cancer surveillance**

This research is specific to bladder cancer. The goal of this research is to develop an endoscopic imaging technology that combines white-light-cystoscopy (WLC) with intravesical detection of positron (beta+) -labeled deoxyglucose (DG), the standard contrast agent for malignant metabolism, for more effective outpatient surveillance and treatment management of bladder cancer. The initial stage of this research aims to develop an endoscopic position sensitive beta-radiation-detection method for in situ detection of positron emission. This research also aims to evaluate if endoscopic detection resolves positron-emission at a higher spatial resolution or at a lower dose than is possible by the whole-body PET.

**Sponsor:** University of Oklahoma

**PI/PD:** Daqing Piao

**CAREER: Material Design and Research Oriented Multidisciplinary Education: Amorphous to Nanocrystalline Electronic Materials with Applications to Thermoelectrics**

This research plan aims to develop a novel class of bulk electronic materials based on amorphous and nanocrystalline structures with sub-10 nm crystallites and to control their thermoelectric properties via a combined theoretical and experimental effort. The principal investigator will adopt a synthesis method that is scalable for manufacturing; hence, the developed materials must be efficient, cost effective, thermally stable, mechanically robust, and appropriate for batch processing.

**Sponsor:** National Science Foundation

**PI/PD:** D. Vashaee

**STIR: High Performance Thermoelectric Cryo-coolers based on II-VI Low Dimensional Structures**

This project targets development of a high-performance, thermoelectric (TE) cooler with ZT > 3; which is fabricated using low-dimensional structures or “superlattices” (SL) constructed from Group II-VI semiconductors, i.e. HgCdSe (MCS) and HgCdTe (MCT). This technology could be immediately used in high-performance, infrared (IR) imaging systems of interest to astronomy, medical imaging, search-and-rescue and the military. Monolithic integration with IIVI IR sensors is possible since the proposed cooler is made from similar materials. This integration will extend component lifetime and provide a very fast cooling response due to the small thermal mass of the cooler and excellent thermal contact.

**Sponsor:** United States Army Research Office

**PI/PD:** D. Vashaee

**Digital Micro Neural Sensing with Inductive Harvesting**

The goals are: 1) Transition the existing MNI RFID functional blocks to the UMC180nm CMOS; 2) develop and integrate a digital 100,000 MicroNeural Interface (MNI) based on inductive coupled powered and Megabit optical communications. Objectives include: 1) Convert the existing IBM CMOS MNI to a simplified version (without ADC) supporting the "time-stamped" mode only for use with an optical LAN communications interface. 2) Design of a COTs based optical based communications interface; 3) Validate neural bandpass amplifier and in situ harvesting; 4) Migration of the validated l80nm IBM MNI blocks will result in two 180nm UMC fabrication runs.

**Sponsor:** University of Texas at Dallas

**PI/PD:** Chris Hutchens

**Planning Grant: I/UCRC for Systems Electromagnetic Compatibility**

OSU’s Robust Electromagnetic Field Testing and Simulation Lab will engage industry partners to identify and solve problems that exist due to electromagnetic interference at a system level. The problems will extend from a simply enclosed cavity analysis to fully functional integrated platforms. Examples of the problems include predicting emissions from printed circuit boards radiating inside an enclosed cavity with apertures, validating the performance of different absorber materials placed inside cavities with complex operational electronics via simulation and measurements, and electromagnetic compatibility problems while performing system integration in unmanned aerial systems. This work complements the work at the center at MS&T.

**Sponsor:** National Science Foundation

**PI/PDs:** Chuck Bunting, Vignesh Rajamani, James West

**Trans-Bronchial Spectral Optical Tomography for Imaging Lung Lesions Distant from Bronchial Airway**

The broad objective of this project is to develop a pre- or intra-operatively compatible optical imaging technology for the detection and image-guided intervention of pulmonary nodules located within centimeters depth from the bronchial airway. The near term objective of this project is to demonstrate the technical feasibility of *ex vivo* trans-bronchial spectral diffuse optical tomography in localizing emulated lung nodules of which the size, depth, and tissue contrast have clinical implications.

**Sponsor:** Intuitive Surgical Operations, Inc.

**PI/PDs:** Daqing Piao

CVHS: Bartels

**Measuring the Shielding Effectiveness of Surrogate Samples**

Reverberation Chambers are used to measure the Shielding Effectiveness (SE) of different materials because it exposes the material to a uniform and isotropic field from multiple angles of incidence. In this project, the SE of surrogate samples will be measured using the nested reverberation chamber measurement approach. The SE measurement is based on the comparison of the electromagnetic power without the sample on the secondary chamber wall to the electromagnetic power when the sample is present on the wall of the secondary chamber. The received power will be measured over the frequency range of 700 MHz to 8 GHz.

**Sponsor:** Applied Research Associates, Inc.

**PI/PDs:** Vignesh Rajamani, Chuck Bunting

**High Coefficient of Performance Semiconductor and Metal Superlattice-Based Thermoelectric Coolers for Infrared Focal Plane Arrays Cooling**

The first objective is to optimize the design of Hg1-xCdxTe/Hg1-yCdyTe SLs to minimize the thermal conductivity and maximize electrical conductivity and thermoelectric power within constraints imposed by material properties, MBE growth and device fabrication. The calculations will focus on Hg0.8Cd0.2Te/Hg0.2Cd0.8Te SLs, which have large barrier heights. The second objective is to measure the ZT and COP characteristics of the devices and compare the measured results with those predicted by modeling.

**Sponsor**: EPIR Technologies, Inc.

**PI/PD:** D. Vashaee

**Embedded Computer Systems Curriculum Development with Intel Atom based DE2i-150 FPGA Development Kit**

The project integrates Intel ® Atom-based embedded systems into lab exercises in the Embedded Computer Systems course. The six lab exercises and the final project will focus on a mobile robot constructed from the iRobot Create. The lab exercises will focus on the different aspects of building this intelligent mobile robot, such as communication (serial communication and TCP/IP networking), sensor interfacing (IR, Webcam, Kinect RGB D), multi-threaded programming for reactive control, etc. The final project will be a robot competition. Each group of students will design an intelligent mobile robot with the available sensors to accomplish some real world tasks.

**Sponsor:** Intel Corporation

**PI/PD:** Weihua Sheng

**Thermoelectric energy harvesting devices for structural components**

The product of this project will be stabilized, thick film, nanostructured thermoelectric energy harvesting devices with high figure of merit based on bismuth telluride alloys that can be attached to any structural component to take advantage of the temperature difference between any two surfaces of the structure in service and generate power from waste heat. Attachment of thick film thermoelectric devices to structural components is a simpler and cost-effective method and an enabling technology compared to thin film thermoelectric devices.

**Sponsor:** Oklahoma Center for the Advancement of Science and Technology, Amethyst Research Inc.

**PI/PDs:** Daryoosh Vashaee

Materials Science and Engineering: Ranji Vaidyanathan

**Scalable Rapid Solar Hydrogen Production via Photo-Bio-Chemical Hydrolysis**

In this project, scientists from the Helmerich Advanced Technology Research Center combine their expertise to implement a bio-mimetic photo-thermal electrolyzer that, if successful, can result in a significant leap forward in solar hydrogen technology. The approach relies on Drs. Vashaee and Tayebi’s recent discovery that certain hybrid organic/inorganic particles are capable of splitting water molecules when the particles are dispersed in water. The system consists of semiconducting particles coated with their recently synthesized bio-compatible additives. This concept has the potential to place Oklahoma in a position to contribute effectively in the potentially large market of solar hydrogen industry.

**Sponsor**: Oklahoma Center for the Advancement of Science and Technology

**PI/PDs**: Daryoosh Vashaee, Jerzy Krasinski

Materials Science and Engineering: Lobat Tayebi

Graduate College: Ken Ede

**Photonic-needle assessment of hepatic steatosis**

The goal is to establish a rapid, objective, and minimally-invasive deep-tissue sensing technology to quantify the intensity of hepatic steatosis and to differentiate macro-steatosis from micro-steatosis of the donor-liver, assessments vital to the outcome of many liver transplants. The objective is to develop a method based on an ultra-fine fiber needle that combines near-infrared reflectance spectroscopy with low coherence interferometry, and to test the sensitivity and specificity of this method in quantifying the volume-content as well as the size-distribution of fat vacuolae in phantom and animal models of hepatic steatosis.

**Sponsor:** Oklahoma Center for the Advancement of Science and Technology

**PI/PDs:** Daquing Piao

Center for Veterinary Health Sciences: K.E. Bartels, J.W. Ritchey, G.R. Holyoak

**SHB: Type I (EXP): Context-aware Ubiquitous Human Health Monitoring**

The project objective is to develop a ubiquitous human health monitoring system that collects not only vital signs, but also daily activities and environmental context of a human subject in an everyday life setting. From these collected data, higher level knowledge such as anomalies will be extracted to assist in health evaluation, medical diagnosis/prognosis or healthcare delivery. Such a system is called a Smart Health Monitoring (SmartMon) System, which will help realize ubiquitous health monitoring and healthcare delivery. The major research tasks focus on the development and evaluation of the proposed hardware platform and theoretical framework of the SmartMon system.

**Sponsor:** National Science Foundation

**PI/PDs:** Weihua Sheng, Qi Cheng

**Collaborative Research: Manipulating Terahertz Waves Using Three-Dimensional Metamaterials**

THz waves have proven challenging to control due to a paucity of electromagnetic materials with an effective response at THz frequencies. This “THz gap” results in a great impediment for the development of functional THz optical components and systems. In view of these challenges, the objective is to develop a synergetic approach that incorporates Transformation Optics (TO) theory, the tunable metamaterials design under effective media approximation, the scalable 3D fabrication technologies, and the experimental validation to explore a range of novel Terahertz optical components: 1) TO-enabled aberration free THz imaging lens, and 2) an integrated THz lab-on-chip sensing platform.

**Sponsor:** National Science Foundation

**PI/PDs:** Weili Zhang, John O’Hara

**Collaborative Research: CI-ADDO-NEW: An Open Memory Array Compiler Framework to Support Devices, Circuits and Systems Research**

The objective is to enable memory and computer system research by creating an open-source memory compiler infrastructure called Open-RAM, to be used by architects and system designers, circuits/device researchers, and CAD researchers. No current memory compilers allow researchers to experiment from the system to device level using real, synthesized memories. The PI intends to: generate single and multi-port RAM arrays and register files; provide detailed specification for portability and extensibility to future processes; perform automated timing, power, and yield characterization; be interoperable with common academic and commercial tool flows; verify correctness of memories, methodology, and characterization in two prototype chips.

**Sponsor:** National Science Foundation

**PI/PD:** James E. Stine

**A Tool for Posture Assessment and Personalized Training**

This project seeks an integrated multi-sensor approach to develop a comprehensive yet economic tool for functional and dynamic posture/gait assessment, which is expected to surpass existing ones by providing accurate and reliable motion measurement as well as supporting personalized in-home training via serious health games. The proposed research is translational in the sense that it incorporates the most recent advancements in sensor technology and tends to bridge the gap between lab and clinic.

**Sponsor:** Oklahoma Center for the Advancement of Science and Technology

**PI/PD:** Guoliang Fan

**RF Physical Layer Authentication via Watermarking**

The purpose of this project is to test the viability of several physical layer authentication schemes in both simulated and real-world scenarios in order to inform further development of those methods that may be of interest to the U.S. Navy. This project will perform testing of the impact of these schemes on both watermark aware & non-watermark aware receivers. A WACR should be able to reliably process a physical layer authentication signal. Ideally the performance of a standard non-WACR receiver should not be degraded by that same signal and the presence of the authentication signal should remain unknown.

**Sponsor:** Exelis, Inc. for Department of Defense Naval Research Laboratory

**PI/PDs:** George Scheets, Keith A. Teague

**Synthetic Aperture Radar Processing for Change Detection**

The work addresses the processing of synthetic aperture radar imagery to detect changes of a land environment over time. The work is associated with coherent imaging radar systems developed by Sandia National Laboratories. The researcher will investigate automated methods to apply accurate phase-error autofocus functions to all pixels in radar images. The researcher will also investigate image-registration algorithms used in determining the coherent change between images.

**Sponsor:** Sandia National Laboratories for U.S. Department of Energy

**PI/PD:** James West

**Exploration and Evaluation of Nanometer Low-Power Multi-Core VLSI Computer Architectures**

As the complexity of computer architectures increases, engineers resort to efficient streams of computer programs or design flows to accomplish the task of producing Very Large Scale Integration (VLSI) architectures. The research emphasis in this proposal is placed on designing a complex VLSI multi-core architecture using an elaborate design flow or sequence of steps. The major concern of this design flow is whether this project can create a design which can be implemented that outperforms other similar architectures in terms of propagation delay and area consumption, yet still produces a significant savings in terms of the amount of power consumed.

**Sponsor:** United States Air Force

**PI/PD:** James E. Stine

**Time-domain Spectroscopy Characterization of Novel Terahertz Devices and Structures**

Characterizations (testing) of terahertz components and devices will be carried out, including transmitter and receiver modules and novel subwavelength terahertz structures using terahertz time-domain spectroscopy for Petawave Networks, Inc., Lenexa, Kansas. Within this project, only testing will be done. Equipment to be used includes: Terahertz transmission spectroscopy system; Terahertz reflection spectroscopy system; Terahertz cryo spectroscopy system; Coherent Verdi pumping laser (532 nm, 6 W); and KM Labs Ti:sapphire femtosecond laser (800 nm, 500 mW, 26 fs). Dr. Weili Zhang will oversee the terahertz testing experiments. Such testing services are not commercially available to the sponsor, Petawave Networks, Inc.

**Sponsor:** Petawave Networks, Inc.

**PI/PD:** Weili Zhang

**CAREER: Content-Based Image and Video Coding Using Higher-Level Models of Human Vision**

Effective image and video coding methods capitalize on low-level aspects of the human visual system (HVS). A strategy is to place the errors into regions which can better hide compression artifacts, an approach which can be guided by computational models of early/low-level HVS processing. The investigator will research how compression artifacts influence the HVS's ability to process and interpret images and video. Three areas are investigated: new models of visual masking which take into account image recognition, appearance-preserving strategies of data quantization, and analysis and quantization strategies which honor rules of visual cognition derived from quality-rating experiments coupled with eye-tracking.

**Sponsor:** National Science Foundation

**PI/PD:** Damon Chandler

**New Methodologies for System-Level Electromagnetic Compatibility (EMC) Analysis of Electronic** **Systems**

The project aims to formulate, implement and test methodologies for enabling enhanced EMI/EMC design of electronic systems. The CAD methodologies offer a generalized perspective of analyzing EMI coupling scenarios faced by engineers. The methodologies and framework are independent of computational tools or techniques. Instead, they provide ideas based on Artificial Neural Networks for integrating existing methods to handle problems of higher complexities, while reducing computational overhead. Study aims are to identify sensitive parameters in an EM environment using statistical analysis, to decide, for a given EMI coupling scenario, whether deterministic tools are required in the overall analysis of electronic systems.

**Sponsor:** The University of Toledo for the National Science Foundation

**PI/PD:** Charles F. Bunting

**Fire Protection Publications**

**Fire Safety Solutions for Oklahomans Who Have a Hearing Impairment**

The goal of this fire prevention and safety program is to improve the safety of Oklahomans who are deaf or hard of hearing. FPP will collaborate with ABLE Tech and Fire Service Training to provide technical support, train, implement and evaluate smoke alarm installation for Oklahomans statewide who have a hearing impairment.

**Sponsor:** Oklahoma Assistive Technology Foundation for the United States Department of Homeland Security – FEMA

**PI/PDs:** Nancy J. Trench

Fire Service Training: Caroline Reed

**Fire Safety Solutions for Oklahomans with Disabilities 2013**

The goal for Solutions 2013 is education that will improve the safety of Oklahomans with disabilities. To meet this goal, FPP will collaborate with Oklahoma ABLE Tech and provide technical support in two major projects:1) Installation of specialized smoke alarms for individuals who are deaf or hard of hearing that reside in targeted areas of Oklahoma, and 2) Create two training courses for firefighters and Emergency Medical Technicians on how to serve Oklahomans with disabilities in fire prevention and safety.

**Sponsor:** Oklahoma Assistive Technology Foundation for the United States Department of Homeland Security – FEMA

**PI/PD:** Nancy J. Trench

**Fire Service Training**

**Assistance to Firefighter Grant for Purchase of a Mobile Training Tower**

The grant provided funding for a four level tower designed as a portable training simulator for first responders. The tower can be configured to provide various training scenarios. The unit is self-contained to provide lighting power for night drills. The Mobile Training Tower allows OSU-FST to provide training in rural areas where training facilities are not available to fire departments. With this unit, OSU-FST can provide specialized training in the areas of ladder skills, fire hose advancement in stair wells, high rise firefighting, rope rescue, high angle rescue, confined space rescue, and search and rescue in structures.

**Sponsor:** Department of Homeland Security Federal Emergency Management Agency

**PI/PD:** Caroline Reed

**Grain Bin Safety Program**

The project is a joint effort of Fire Service Training and Biosystems and Agricultural Engineering. OSU’s FST and BAE departments will jointly develop a comprehensive hands-on agricultural safety awareness level training program as well as an operations level agricultural rescue training program, both emphasizing grain-related hazards. The two target audiences will be firefighters and agricultural workers, both high hazard occupations. The awareness level training will be focused on prevention. The operations level training will be focused on rescue.

**Sponsor:** United States Department of Labor – Occupational Safety and Health Administration

**PI/PDs:** Jason Louthan

Biosystems and Agricultural Engineering: Carol Jones

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**Sponsor:** Oklahoma Assistive Technology Foundation for the United States Department of Homeland Security – FEMA

**PI/PDs:** Caroline Reed

Fire Protection Publications: Nancy J. Trench

**Safety Cabinet Next Generation Design**

Justrite Manufacturing Company, a leading producer of safety cabinets, is working with OSU to extend its product analysis and testing. The New Product Development Center (NPDC) and Fire Service Training (FST) at OSU will work with Justrite to engineer and test innovative concepts that will cement Justrite as the market leader in safety cabinet design and manufacture. NPDC and FST will provide modeling, analysis, and testing of new safety cabinet design concepts which will allow Justrite to meet and/or exceed the current legislative requirements and standards, as well as gain a competitive advantage in the marketplace.

**Sponsor:** Justrite Manufacturing Company, LLC

**PI/PDs:** Ed Kirtley

New Product Development Center: Robert Taylor

**National Fire Academy State Fire Training Grant**

OSU’s Fire Service Training will deliver a series of training programs in cooperation with the Federal Emergency Management Agency (FEMA) and the U.S. Fire Administration’s National Fire Academy (NFA) to enhance the capabilities of the fire service in Oklahoma. Courses for Emergency Responders will be provided throughout the state in both conference settings as well as single course deliveries. The trainings will be provided in rural and metropolitan settings in an effort to bring the training to the responder locally.

**Sponsor:** Department of Homeland Security Federal Emergency Management Agency National Emergency Training Center

**PI/PD:** Caroline Reed

**Rescue Equipment for Training Trailer**

The award was for the purchase of rescue equipment for a training trailer including items such as pulleys, rescue racks, straps, ropes, etc.

**Sponsor:** Oklahoma Office of Homeland Security

**PI/PD:** Caroline Reed

**Industrial Engineering and Management**

**EAGER: US IGNITE: A Gigabit Network and Cyber-Physical Framework for Advanced Manufacturing**

In this US Ignite (EAGER) project, the goal is to demonstrate an ultrafast high gigabit application in the area of Advanced Manufacturing. The manufacturing domain is micro/meso devices assembly, which involves the manipulation and assembly of intricate micron and millimeter sized objects. Overall, the objective is to develop and demonstrate an Advanced Manufacturing application through the creation of a Collaborative Meso/Micro Assembly Test Bed (COMAT) whose engineering life cycle is accomplished in an agile manner using ultra fast high gigabit networks which support collaboration among distributed tools and resources for design analysis, assembly planning, simulation and finally assembly.

**Sponsor:** National Science Foundation

**PI/PD:** J. Cecil

**REU SITE: Research Experiences in Information Centric Engineering (ICE)**

The goal of this REU Site initiative is to provide meaningful research experiences to a new generation of engineers and scientists in emerging process domains with an Information Centric Engineering emphasis. Useful research experiences provided to undergraduate students will encourage them towards graduate programs and research careers in these leading edge research areas. The resources of the Center for Information Centric Engineering at OSU will be used by the REU students to conduct research in manufacturing (micro devices assembly) and biomedical (virtual surgical environments) domains.

**Sponsor:** National Science Foundation

**PI/PD:** J. Cecil

**Deployable Greenhouse for Food Production on Long-Duration Exploration Missions**

The project is to design, develop, build and test a deployable greenhouse system for the X-Hab

Academic Innovation Challenge. Goals of the project include the short-term goal of an

interdisciplinary senior design project to design, build and evaluate a horizontally oriented

habitat and a long-term goal to develop capabilities in education, research, and outreach in the field of space habitat design. This will include both technical engineering and outreach efforts. Faculty with diverse specialties from across the schools at OSU will participate in the project with the goal of developing technology and designs to facilitate human habitation in outer space.

**Sponsor:** National Space Grant Foundation for NASA

**PI/PDs:** J. Cecil

Mechanical and Aerospace Engineering: Jamey D. Jacob

Architecture: Steve O’Hara

Biosystems and Agricultural Engineering: Paul Weckler, Ning Wang

**Real-time Decision Support System for Healthcare and Public Health Sector Protection**

Through this subcontract, the PI will continue the process of making the Real-time Decision Support System for Healthcare available to the public. This system takes the guesswork out of decision making during a public health emergency by pulling information from appropriate sources to provide real-time information to decision-makers. The product was developed while the PI was at the University of Louisville through a grant from the National Institute for Hometown Security. The PI will identify potential customers in three markets: public health, first responders, and hospitals. Execution of sales and marketing plans will lead to commercialization of the technology.

**Sponsor:** University of Louisville Research Foundation, Inc. for the National Institute of Hometown Security, Inc. for the U.S. Department of Homeland Security

**PI/PDs:** Sunderesh Heragu, Manjunath Kamath, Camille DeYong

**Collaborative Research: Risk-Averse Cluster Detection in Network Models of Bigdata Under Measurement Uncertainty**

This project will establish theoretical and computational foundations that lead to polyhedral and probabilistic approaches for detecting low-diameter clusters in network models of social and biological big-data that are subject to measurement errors and incomplete information. The proposed polyhedral study of the "k-club" cluster model is novel as it is the first nonhereditary graph property to be investigated in the polyhedral combinatorics literature. Conditional-value-at-risk-constrained k-club detection models in a random graph will be studied to produce risk-averse solutions. Sampling-free exact decomposition algorithms will be investigated that exploit the combinatorial structure of the sample space.

**Sponsor:** National Science Foundation

**PI/PD:** Baski Balasundaram

**Black Ice Detection and Road Closure Control System for Oklahoma**

A major obstacle to widely implement the black ice detection and warning system is that current sensors specific for black ice detection are too expensive. Typically they cost more than $1,000 per unit. So, it is economically impractical to adopt existing ice sensors for black ice detection across Oklahoma. To tackle this challenge, an objective of this project is to develop a functionally competent and economically feasible sensing system for black-ice detection by using regular temperature, humidity, and light sensors, which are much more viable in terms of cost with less than $100 per unit, to replace expensive ice sensors.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PDs:** Tieming Liu

Arts & Sciences: Hongbo Yu

Division of Agricultural Sciences and Natural Resources: Ning Wang

University of Oklahoma: Yang Hong, Jeff Basara

**Collaborative Research: US IGNITE: EAGER: Exploring Ultrafast Networks for Training Surgeons Using Virtual Reality Based Environments**

The goal is to develop and demonstrate new virtual reality based applications for training medical residents and doctors in microsurgical techniques using the Global Environment for Network Innovations (GENI) infrastructure and capabilities. Surgical training is usually limited to face-to-face situations where the expert surgeon and trainees are in the same room performing intricate procedures. Since experts in microsurgical techniques are not available in most parts of the country, such training is not readily available to many medical students. The virtual reality based surgical training application will address this challenge by eliminating the need for experts and trainees to be co-located.

**Sponsor:** National Science Foundation

**PI/PD:** J.A. Cecil

**EAGER/Collaborative Research: Web Architectures for Extensible, Adaptable and Scalable Manufacturing**

While the Internet is used for communication and collaboration of engineering activities in manufacturing, the impact has been less than expected. This investigation answers: Is there an architecture that will enable manufacturing enterprises to pursue new collaborations while accepting the shortcomings of such an architecture as well as recognizing the complexities in a broader manufacturing life cycle context? If such an architecture can be formalized, what would be its core characteristics? The project will throw light on this problem with a view towards laying foundations and requirements for an architecture that can foster such a community involved response.

**Sponsor:** National Science Foundation

**PI/PD:** J.A. Cecil

**Clique Relaxations in Biological and Social Network Analysis: Foundations and Algorithms**

The project proposes a tentative taxonomy classifying previously defined clique relaxations under a unified framework. The project builds on elementary graph-theoretic properties of cliques to provide a hierarchically ordered classification of clique relaxation models. The taxonomy is complemented by providing tight bounds relating the clique properties guaranteed, in a relaxed form, by the so-called first-order clique relaxations. This provides solid grounds for a more comprehensive understanding of the relations among the known clique relaxation models, which could serve as a guide for practitioners in selecting a cluster model suited for a particular application.

**Sponsor:** Texas Engineering Experiment Station for AFOSR

**PI/PD:** Baski Balasundaram

**Motorcycle Crash Causation Study**

The following are the objectives of this study: 1) Determine the main human, vehicular, environmental and roadway factors that contribute to motorcycle crashes and impact crash avoidance; 2) Identify the types of motorcycle crashes; 3) Assess the effectiveness of existing countermeasures including protective gear and rider training/education; 4) Identify additional feasible countermeasures/interventions that can reduce motorcycle crashes and crash injuries; and 5) Estimate the risk factors for motorcycle crash involvement.

**Sponsor:** United States Department of Transportation - Federal Highway Administration, American Motorcyclist Association

**PI/PD:** J.W. Nazemetz

**Industrial Assessment Center Program**

The mission of the IAC is to assess energy, waste, and productivity practices with the purpose of enhancing the management of the same within the clients enterprise and to share best practices with other IACs, while educating and training the next generation of energy, waste, and productivity professionals. The IAC will focus on IOFs and small and medium-sized manufacturers located within Oklahoma, Kansas, western Missouri, western Arkansas, eastern New Mexico, and beyond, as coordinated by our field managers. The latest technology will be employed to perform assessments that focus on energy, waste, and productivity issues in the clients’ facilities.

**Sponsor:** Department of Energy

**PI/PD:** William J. Kolarik

**Development of an Available-to-Promise Decision Support System for Webco Industries**

The overall objective of this project is to develop an Available-To-Promise Decision

Support System (ATP-DSS) for Webco Industries. ATP-DSS will have the following functions:

• Calculate for each order if the client specified due date could be met;

• If not, provide the earliest available delivery date subject to other commitments;

• Suggest optimal allocations of tube inventory to satisfy orders.

The system will provide multiple solutions for the manager to choose. Solutions will be provided with considerations of Webco’s available inventory, production plan, and customer order specifications.

**Sponsor**: Webco Industries, Inc.

**PI/PDs:** Tieming Liu, Baski Balasundaram

**Materials Science and Engineering**

**Modification of the Coefficient of Thermal Expansion Analysis Suite (CTEAS)**

Support from GE Global Research will be used to improve the existing Coefficient of Thermal Expansion Analysis Suite (CTEAS) software developed as a freeware by the principal investigator Dr. Sarin. Some areas for improvement of CTEAS software include: 1) Matlab based GUI interface for the CTEAS software, 2) Ability to install and run the CTEAS without the requirement for a Matlab license, 3) Corrected and updated user manual.

**Sponsor:** GE Global Research

**PI/PD:** Pankaj Sarin

**SPTC Internship - CleanNG**

The 2015 TRIP program is focused on summer internships for students seeking to gain valuable professional experience through working for a transportation related company or a government organization/agency such as a department of transportation over a period of 10 to 12 weeks. OSU on behalf of the Southern Plains Transportation Center funded a portion of the stipends, while the employer provided a portion of the stipends. This award provided summer internships with CleanNG.

**Sponsor:** University of Oklahoma for the Southern Plains Transportation Center for the Oklahoma Department of Transportation SPR

**PI/PD:** Ranji Vaidyanathan

**Oxidation Resistant UHTCs for Reentry Environments**

The overall goal of this research project is to develop self-protective, high temperature oxidation resistant HfB2 based ultra-high temperature ceramics (UHTCs) for reentry environments. The proposed work has the potential to trigger a paradigm shift in the way research on ultra-high temperature material systems will be conducted. It will underscore the importance of in-situ experimental approach to discover materials for use at extreme conditions. A direct outcome of the project will be real-time information on surface chemistry, and decomposition of UHTCs when they are exposed to high temperatures (up to 3650 F) in air.

**Sponsor:** University of Oklahoma for NASA (EPSCoR)

**PI/PD:** Pankaj Sarin

**Tape Casting of Solid Electrolyte Layers**

In consultation with Frontier Electronic Systems Corp., the Smay Lab identified a need to fabricate tape-cast layers of Li-based solid electrolytes for solid state batteries. To create these tape cast layers required a multi-step process: 1) Synthesis of oxide ceramic powders suitable for tape-casting, 2) Development of a ceramic tape casting slurry, and 3) Successfully tape casting layers sufficiently thin for battery electrolyte layers.

**Sponsor:** Frontier Electronic Systems Corp

**PI/PD:** Jim Smay

**Nanodiamond for biological imaging applications**

The goal is to develop nanodiamond powders as replacements for conventional fluorescent agents used in biological imaging applications. The nanodiamond powders will be optically, thermally, and chemically stable and will be tailored to emit light efficiently at four distinct optical emission wavelengths used in biological imaging applications. It is expected that the nanodiamond powders will be resistant to photobleaching, will be non-toxic and biocompatible. The nanodiamond material will significantly reduce the complexity involved in sample preparation and acquisition of images for biological applications. COARE Biotechnology Inc. has expressed interest in commercialization of the product upon demonstration of proof-of-concept.

**Sponsor:** Oklahoma Center for the Advancement of Science and Technology

**PI/PDs:** Nirmal Govindaraju, Raj N. Singh

**Development of Novel, Compartmentalized Vacuum Insulation Composites for Structural Applications**

MaxQ is developing low cost, ultra-low thermal conductivity, high strength, compartmentalized vacuum insulation composites for structural applications. MaxQ’s innovative approach seeks to achieve mechanically robust high thermal insulation capability (R-20 to R-30) by fabricating vacuum compartments within the sandwich core through a scalable manufacturing process. The compartmentalized vacuum core approach provides an exceptional capability to mass produce large panels that can be machined into custom shapes and sizes at construction sites, while preserving the insulation capacity (compartmentalized vacuum core). Dr. Vaidyanathan’s Next Generation Materials Laboratory at Helmerich Research Center will perform mechanical testing and surface characterization of MaxQ’s composite materials.

**Sponsor:** MaxQ Research, LLC for OCAST

**PI/PD:** Ranji Vaidyanathan

**Radiation Smart Structures with H-rich Nanostructured Multifunctional Materials**

Through this NASA EPSCoR award, radiation smart structures and materials with H-rich nanostructured multifunctional materials will be developed and built for shielding astronauts from ionizing radiation during human missions beyond low-Earth orbit. The approach is interdisciplinary and involves research groups in Materials Science and Engineering at OSU Tulsa, the Dept. of Physics and Mechanical and Aerospace Engineering at OSU Stillwater. The research will find applications in a number of radiation based industries including medical physics and nuclear power generation in which high-strength, lightweight radiation shielding materials and appliances are needed.

**Sponsor:** University of Oklahoma for NASA EPSCoR

**PI/PDs:** Ranji Vaidyanathan

Mechanical and Aerospace Engineering: Raman Singh

Physics: Eric Benton

**A Physical Test Model Based on Stress-Shadowing to Optimize Drilling Operations During Fracking**

In this proof of concept OARS effort, the OSU-Petroquest team will develop a physical-scale laboratory-based experimental module to test the stress-shadow hypothesis. The fundamental data from this novel effort will be used to formulate guiding equations for fracture propagation in unconventional reservoirs, which in turn will be converted to a commercial software package licensable through OSU.

**Sponsor:** Oklahoma Center for the Advancement of Science and Technology

**PI/PDs:** Ranji Vaidyanathan

Geology: Priyank Jaiswal

**Direct Ink Writing Process Improvements**

The goal is to investigate and enhance the direct ink writing process (also known as “3D printing” and “robocasting”) to enable fabrication of 3D objects with microscale features. This project will expand the design space for many applications and will lead to high-impact publications describing both the processes and resulting materials and structures. OSU researchers will design and fabricate a mixing nozzle device capable of mixing two or more ink materials at arbitrary compositional ratios. OSU researchers will also develop and provide custom software for running the mixing nozzle printhead.

**Sponsor:** Lawrence Livermore National Security, LLC

**PI/PDs:** James Smay

**I-Corps: Nanomaterials for Thermal Management of Power Electronics**

The long-term objective is to develop a new nanocrystalline diamond based thermal management technology for wide bandgap semiconductor (WBGS) power electronics that will directly extract heat from devices. The expected outcomes of this I-Corps project are: 1) identification of market size and potential, customer interest and feedback for the proof-of-principle WBGS power semiconductor thermal management technology, 2) development of a business plan based on market research and customer interactions, 3) tailoring the technology based on customer feedback, 4) identifying and attracting additional funding for commercializing the technology, and 5) ascertaining potential partners for commercializing and/or licensing the technology.

**Sponsor:** National Science Foundation

**PI/PD:** Raj Singh

**Nano-Particles for Drug Delivery and Treatment of Urinary Tract Infections**

A critical unmet need exists for the development of nanotherapeutics that can serve as targeted molecular agents for eradicating a variety of persistent intracellular infections of the urinary tract. Therefore, there is an urgent need to develop targeted, low-dosage antibiotic treatments for eradicating a variety of persistent intracellular infections of the urinary tract. The research lays the foundation for such treatments by demonstrating that diamond nanoparticles (DNPs) are viable platforms for efficient delivery of antibiotics such as amoxicillin to kill bacteria in cells. It is envisaged that the research will lead to novel targeted low-dosage DNP-based UTI treatments.

**Sponsor:** Oklahoma Center for the Advancement of Science and Technology

**PI/PDs:** Raj Singh

Center for Health Sciences: Rashmi Kaul, Anil Kaul

**RDIP: Interns for absorbed natural gas composite tanks**

Undergraduate interns will be trained to develop non-cylindrical type of all composite adsorbed natural gas storage vessels for passenger cars for CleanNG LLC. The technology will be based on technologies being developed by CleanNG and OSU under a currently funded NSF Phase I STTR project as well as a concurrent OARS accelerated project. The technology to be developed will also be partially based on adsorbent technologies being developed by the PI and the mentor as well as those being developed at Oak Ridge National Laboratory. The interns will work on a project that could revolutionize the natural gas vehicle industry.

**Sponsors:** Oklahoma Center for the Advancement of Science and Technology, CleanNG LLC

**PI/PD:** Ranji Vaidyanathan

**Cation Substituted CCTO Super Capacitors**

To demonstrate the superior performance of CCTO:Al dielectrics, CCTO films will be fabricated using a sol-gel process. The CCTO based capacitors will be used for performance comparisons. CCTO:Al films will be fabricated in a similar manner. The CCTO:Al films will be deposited on metallic electrodes. The sol-gel films will be calcined at elevated temperatures to remove solvent to form the dielectric base for capacitors. Characteristic X-ray diffraction peaks will assure that CCTO:Al samples have the proper crystalline quality. Energy dispersive X-ray analysis will determine composition and Al content of the sol-gel grown CCTO:Al dielectric wafers to determine optimum Al% substitution.

**Sponsor:** US Ferroics for Oklahoma Center for the Advancement of Science and Technology

**PI/PD:** Raj Singh

**Nanodiamond Resonators for Sensing Applications**

The PIs propose to develop "proof-of concept" nanodiamond pillar (NDP) sensor technology for detecting trace quantities of chemical and biological substances. The research will result in robust, portable, and compact sensors that can be deployed in a variety of environments. Two Oklahoma firms have been identified that are interested in a commercialization partnership, and a third Oklahoma company has expressed interest in NDP sensors. The companies will partner in demonstration of the concept. Of the companies identified, one is a manufacturer of sensors and switches, the second produces high purity chemicals, and the third monitors air quality.

**Sponsor:** Oklahoma Center for the Advancement of Science and Technology

**PI/PDs:** Nirmal Govindaraju, Raj Singh

**Medishine**

Phase I involves development and refinement of the prototype, which is a device for treatment of Obstructive Sleep Apnea (OSA). The first task focuses on development of small-batch manufactured prototypes of the device. The second task involves assessment of sleep data and evaluation of device effectiveness. The last task in Phase I focuses on testing and product refinement. Phase II is the IRB testing and customer modeling phase. An alpha prototype of the new OSA treatment system will be completed. The Gen 2 prototype and IRB testing will be done by late 2014. Initial sales will be ready by 2015.

**Sponsor:** National Collegiate Inventors and Innovators Alliance

**PI/PD:** Ranji Vaidyanathan

**All-Composite Storage Tanks for Absorbed Natural Gas**

The Next Generation Materials Laboratory at OSU, in collaboration with CleanNG LLC, will develop and manufacture low-pressure, liner-less, all-composite adsorbed natural gas tanks (Magmacel AD™). The natural gas will be stored at low-pressures using a high-surface area carbon material for adsorption of the gaseous fuel, thus enhancing the safety of the fuel tanks. Several different activated carbon materials including their combinations will be evaluated. OSU will assist CleanNG to produce the prototypes, test and characterize the fuel storage capacity of the adsorbent and improve the mechanical properties of the composites through nano-additives based on natural ingredients.

**Sponsor:** Oklahoma Center for the Advancement for Science and Technology, Clean NG LLC

**PI/PDs:** Ranji Vaidyanathan

**Thermoelectric energy harvesting devices for structural components**

The product of this project will be stabilized, thick film, nanostructured thermoelectric energy harvesting devices with high figure of merit based on bismuth telluride alloys that can be attached to any structural component to take advantage of the temperature difference between any two surfaces of the structure in service and generate power from waste heat. Attachment of thick film thermoelectric devices to structural components is a simpler and cost-effective method and an enabling technology compared to thin film thermoelectric devices.

**Sponsor:** Oklahoma Center for the Advancement of Science and Technology; Amethyst Research, Inc.

**PI/PDs:** Ranji Vaidyanathan,

Electrical and Computer Engineering: Daryoosh Vashaee

**Self Repairable Seals by Crack Healing of Glass and Glass-Ceramic Composites for Solid Oxide Fuel Cells**

A study of the crack-healing in glasses and glass-ceramic composites of varying composition and reinforcement/ceramic phase is proposed to show a systematic correspondence with the physical properties, such as glass transition and softening temperatures, coefficient of thermal expansion, modulus, viscosity, surface energy/tension and creep behavior, thereby elucidating the key materials parameters affecting crack-healing mechanisms.

**Sponsor:** National Science Foundation

**PI/PD:** Raj N. Singh

**Thermal Transport in Diamond Thin Films: Roles of the Nanostructure and Interfaces**

Heat dissipation in high performance microprocessors and power semiconductor devices is a challenge facing the microelectronics industry. One way to remove heat from integrated circuits (ICs) is to use materials with high thermal conductivity in contact with ICs. In this context, a high thermal conductivity material, especially diamond with the highest thermal conductivity of any material, is promising for thermal management of ICs. The research objective is to synthesize layered thin films of diamond in which one layer (nanocrystalline diamond-NCD) will provide smooth surfaces for lower interface resistance and the second layer (microcrystalline diamond-MCD) will result in high thermal conductivity.

**Sponsor:** National Science Foundation

**PI/PD:** Raj N. Singh

**Mechanical and Aerospace Engineering**

**U1C Support**

FSS is contracted with the Navmar Applied Sciences Company to provide engineering design, test, and development of components for a Department of Defense UAS platform. FSS is contracting with OSU’s School of Mechanical and Aerospace Engineering to perform propulsion testing and component UAS platform modifications. The contractor will provide: 1) support for technical meetings with FSS and sponsor; 2) test and evaluation of exhaust cooling duct modification; 3) test and evaluation of modified engine on dyno; 4) test and evaluation of new propeller design on dyno; 5) testing and evaluation of exhaust pipe, 6) support ground and flight tests.

**Sponsor:** Fail-Safe Solutions, LLC for Department of Defense

**PI/PD:** Andy Arena

**EnergyPlus Whole-Building Modeling and Simulation Software Development**

EnergyPlus is a key part of DOE’s building energy-efficiency strategy. In its ongoing program implementation and technical management efforts, the National Renewable Energy Laboratory (NREL) requires the assistance of OSU to provide technical support for new features development and for software defects resolutions.

**Sponsor:** Alliance for Sustainable Energy, LLC for National Renewable Energy Laboratory

**PI/PD:** Dan Fisher

**Plasma Conversion Reactor Evaluation**

Approximately 50 tests will be run of the Plasma Conversion Reactor. Feedstock and natural gas feed into the Plasma Conversion Reactor (PCT), where a controlled frequency and high-voltage plasma is created. Ionization occurs in the effective zone of the reactor driving chain propagation. Once the chain length reaches a sufficient length or molecular mass, the material can no longer exist in the gas phase and migrates to a liquid phase under the present conditions. The liquid is collected in the Product Collector for analysis. Non-liquid phase materials pass through the condenser and are vented/flared as appropriate.

**Sponsor:** PlasMerica, LLC

**PI/PDs:** Jamey Jacob

Biosystems and Agricultural Engineering: Ajay Kumar, Raymond L. Huhnke

**Testing of a New Web Guide System**

Roll-2-Roll Technologies LLC (Roll-2-Roll) has developed a next generation lateral guiding system for narrow web applications using technologies licensed from Oklahoma State University. This includes a proprietary sensor and an advanced control algorithm. Roll-2-Roll would like to test the sensor and control algorithms at Oklahoma State University research facilities. The main objectives for testing are: 1) to quantify the sensor performance with different web materials, and 2) to quantify the guide performance with different web materials and under different operating conditions.

**Sponsor:** Roll-2-Roll Technologies, LLC

**PI/PD:** Prabhakar R. Pagilla

**Development of Metamaterial-Inspired Aerospace Structures for Improved Low-Frequency Acoustic Performance**

There is a need to develop alternative lightweight, compact techniques to improve low-frequency sound absorption within and transmission loss through aerospace structures. The goal of this research project is to design, manufacture and test a prototype metamaterial-inspired aerospace structure (MIAS) for improved low-frequency acoustic performance. In order to achieve this goal the following objectives will be pursued: 1) Analytical and numerical studies on MIAS configurations, 2) Design and fabrication of MIAS prototype, 3) Experimental evaluation of MIAS prototype.

**Sponsor:** University of Oklahoma for NASA

**PI/PD:** James Manimala

**Railgun Launched Unmanned Aircraft System**

The investigator is coordinating the development of a Railgun Launched Unmanned Aircraft System, including design and analysis.

**Sponsor:** General Atomics

**PI/PD:** Jamey Jacob

**Applications Engineers Program – Simulation Projects**

The Applications Engineering Program will conduct between four and eight simulation projects. These simulation projects will be Predictive System Improvement™ projects and/or Local Simulation Services™ projects. Each simulation project will be conducted in conjunction with a Lean implementation project being conducted by a Lean service provider selected by the Alliance. The Alliance Manufacturing Extension Agents and/or the Lean service provider(s) will be responsible for bringing the projects to the Applications Engineering Program.

**Sponsor:** Oklahoma Alliance for Manufacturing Excellence, Inc. for National Institute of Standards and Technology

**PI/PDs:** Dan Fisher

Biosystems and Agricultural Engineering: Dan Thomas

**Collaborative Research: Manufacturing of Complex Lenses for Thermal Imaging, Night Vision and Surveillance Systems**

The objective is to test the hypothesis that when diamond milling brittle materials, the material response and character of the resulting surface and subsurface depends not only on the geometry of the tool-workpiece interaction, but also on the non-steady state nature of the process. Because of the effect on material response, some materials that are not practically diamond turnable can be machined by diamond milling. Research tasks include: 1) Design and construction of a simplified milling configuration, 2) Generation of machined specimens, 3) Surface and subsurface characterization. The outcome will identify conditions for more productive diamond milling of materials.

**Sponsor:** National Science Foundation

**PI/PD:** D.A. Lucca

**Radiation Smart Structures with H-rich Nanostructured Multifunctional Materials**

Through this NASA EPSCoR award, radiation smart structures and materials with H-rich nanostructured multifunctional materials will be developed and built for shielding astronauts from ionizing radiation during human missions beyond low-Earth orbit. The approach is interdisciplinary and involves research groups in Materials Science and Engineering at OSU Tulsa, the Dept. of Physics and Mechanical and Aerospace Engineering at OSU Stillwater. The research will find applications in a number of radiation based industries including medical physics and nuclear power generation in which high-strength, lightweight radiation shielding materials and appliances are needed.

**Sponsor:** University of Oklahoma for NASA EPSCoR

**PI/PDs:** Raman Singh

Materials Science and Engineering: Ranji Vaidyanathan

Physics: Eric Benton

**Nondestructive Evaluation Techniques for Composite Materials with Low Density Gradients**

The main thrust of the Phase I project is to demonstrate the ability of x-ray diffraction computed micro tomography to resolve the microstructure of energetic composite materials with low density gradients. A minimum threshold of 1 micron resolution for a 12.7-mm diameter sample is required, with a goal of 1 micron resolution for a 50.8-mm diameter sample (or 0.25 micron resolution for a 12.7-mm diameter sample). Design will include a safety containment for the energetic composite sample, which embodies the capability for in-situ deformation of the test sample at rates up to 1/sec.

**Sponsor:** Metna Co. for United States Air Force

**PI/PDs:** Jay Hanan

Civil Engineering: Tyler Ley

**Dynamic Data-Driven Motion Planning and Control for Pervasive Situational Awareness Application Systems**

The goal is to leverage and contribute to Dynamic Data Driven Application System (DDDAS) framework to create algorithms that bring together on-demand sensing using UAVs and pervasive sensing using UGSs to support a data-driven application system that provides pervasive battlefield Situational Awareness (SA). Tasks to be performed by OSU include: 1) Perform research on value-of-information-based collaborative sensor allocation in adversarial environments, 2) Perform research on creating distributed algorithms to infer a dynamic model of the battlefield, and 3) Perform experiments to validate algorithms developed in this project.

**Sponsor:** Massachusetts Institute of Technology for Air Force Office of Scientific Research

**PI/PD:** Girish Chowdhary

**Carry Bay Fabrication for LGS**

OSU received a prior award through a government customer to develop the unmanned aircraft system payload carrier. LGS supported OSU through separate funding and they both demonstrated the Carry Bay in July 2014. Through the testing, some updates were needed to make it more robust. Through this current service agreement, LGS requires OSU to complete the updates and provide four (4) Carry Bays.

**Sponsor:** LGS Innovations, LLC

**PI/PD:** Andy Arena

**NUE: Nanotechnology Education for Roll-to-Roll Manufacturing**

Roll-to-Roll (R2R) manufacturing of flexible materials offers advantages over batch processing, including better yields, high speed automation, and potential to mass produce finished materials at lower costs. Since R2R manufacturing and the broader paradigm of additive manufacturing are seen as essential parts of advanced manufacturing, it is essential that these topics are introduced to undergraduate students. The goal is to educate undergraduate students in core nanotechnology topics for high precision R2R manufacturing.The investigators will develop curriculum material in nanotechnology and high precision R2R manufacturing in six undergraduate courses: Introduction to Engineering, Measurements, Manufacturing Processes, Mechatronics, Automatic Control, and Vibrations.

**Sponsor:** National Science Foundation

**PI/PDs:** Matthew Klopfstein, Xiaoliang Jin, Don A. Lucca, Prabhakar Pagilla

**Characterization of Diamond Films by Nanoindentation and Raman Spectroscopy**

This will be a four month effort for the characterization of: 1) the nanomechancial properties of six diamond thin films including hardness and elastic modulus using nanoindentation, and 2) the chemical nature and the resulting residual stress of six diamond thin films using confocal Raman spectroscopy. The results will be presented in a final report and the Project Leader (Lucca) will travel to Bremen to discuss the results with the technical scientific staff of BIAS.

**Sponsor:** BIAS (Bremer Institut für angewandte Strahltechnik GmbH)

**PI/PD:** Don A. Lucca

**Left ventricular dyssynchrony in heart failure: investigation of altered hemodynamics and diagnostic accuracy of MRI using an in vitro phantom model**

The central hypothesis of this study is that the diagnosis of left ventricular dyssynchrony (LVD) using magnetic resonance imaging (MRI) and treatment using cardiac resynchronization therapy can be improved by: 1) quantifying the accuracy of MRI-based assessment of mechanical dyssynchrony maps and internal flow fraction by comparison to high-resolution benchmark datasets obtained on an MRI compatible left ventricle (LV) phantom, and 2) quantifying the mechanistic effects of septal-lateral wall motion delay on the energetics of LV function.

**Sponsor:** Oklahoma Center for the Advancement of Science & Technology

**PI/PD:** Arvind Santhanakrishnan

**Protein-Nanoparticle Photoswitches for Subcellular Imaging**

Super-resolution optical microscopy for subcellular imaging is in need of photoswitchable fluorophores with faster and more efficient switching and a higher number of photons emitted prior to photobleaching. The goal of the research is to develop a novel photoswitchable bioprobe for superresolution bioimaging. The photoswitch will be constructed from green fluorescent protein and silver nanoparticle (GFP-AgNP) conjugate. A potential application of the conjugate biomarkers is the intracellular imaging of cancer cells to reveal their therapeutic response to new drugs, which preferentially block cell movement and metastasis.

**Sponsor:** Oklahoma Center for the Advancement of Science and Technology

**PI/PDs:** A. Kaan Kalkan

Division of Agricultural Sciences and Natural Resources: R. Miller

**U1B Support**

FSS is contracted with the Navmar Applied Sciences Company to provide engineering design, test, and development of components for a Department of Defense UAS platform. FSS is contracting with Oklahoma State University’s School of Mechanical and Aerospace Engineering to perform propulsion testing and component UAS platform modifications. The contractor will provide: 1) support for technical meetings with FSS and sponsor; 2) engine and propeller testing; 3) exhaust cooling duct modifications for UAS; 4) support for ground and flight test.

**Sponsor:** Fail-Safe Solutions, LLC for Department of Defense

**PI/PD:** Andy Arena

**Quiet Propeller Development**

FSS is contracted with Oak Ridge National Laboratory to provide the Department of Defense a propeller design for a UAS platform that has minimal noise radiation. An acoustic liner is sought to dampen the noise emanating from the gas turbine engine that provides power to the propeller. FSS is contracting OSU’s School of Mechanical and Aerospace Engineering to perform design trade studies on propeller configurations that will lead to lower noise signatures. OSU will provide: 1) technical meeting support; 2) perform propeller design trade studies that minimize noise radiation using simplified aerodynamic performance and acoustic radiation codes; 3) technical documentation.

**Sponsor:** Fail-Safe Solutions, LLC for Department of Defense

**PI/PD:** Jamey Jacob

**Acoustic Measurements of SUAS for DHS RAPS 2**

OSU will provide graduate student(s) who will travel from Stillwater to OTC-US (Elgin OK) to acquire acoustic data of SUAS participating in the DHS RAPS 2 program. Data acquisition will consist of fly over and loiter data of SUAS of each vehicle from up to four separate microphones. Data will be processed and documented in a report for each tested DHS SUAS vendor. During the

period of performance, support is expected to include data acquisition on five different vehicles.

**Sponsor:** University Multispectral Laboratories

**PI/PD:** Jamey Jacob

**Carry Bay**

OSU will provide essential engineering, research, development, procurement, modeling & simulation, and test & evaluation capabilities in support of USSOCOM’s goal of rapid acquisition of an under-the-wing payload carrier system for use with the Aerovironment PUMA All Environment Capable Variant (AECV) unmanned aircraft system (UAS). This system will support emergent and ongoing contingency needs under the Special Application for Contingencies (SAFC) program.

**Sponsor:** University Multispectral Laboratories for United States Special Operations Command

**PI/PD:** Andy Arena

**CAREER: Fundamental Studies on Mechanics of Three Dimensional Random Fiber Networks**

The objective is to investigate the relationship between small scale and system-level mechanical properties of materials with discrete fibrous microstructure. The research will address gaps in the mechanics of 3D semiflexible fiber networks by investigating their mechanical properties across various length scales. Specific aims are: 1) investigate the structure of 3D fiber networks and characterize the microstructural scaling properties, 2) quantify the non-affine mechanics of 3D semiflexible networks using a new strain-based non-affinity measure, and 3) develop a microstructure-based 3D homogenization technique that incorporates the non-affine mechanics and long-range correlated randomness of the network structure.

**Sponsor:** National Science Foundation

**PI/PD:** Hamed Hatami-Marbini

**A Study on Nonlinear Adaptive Control for a Continuous Steel Strip Processing Line**

The PI will develop an adaptive controller considering the nonlinear characteristics

of steel strip transmission line under CAL/CGL annealing furnace environment which

requires a strict and sensitive tension control standard. The performance of this controller will be evaluated through model simulations and experiments on a laboratory web platform. Strip compliance under transient and steady temperature distribution will be modeled and the effect will be investigated for the purpose of deriving an adaptive tension controller. The development of a nonlinear estimation method for strip tension and friction for the feedback control of tension of this system will also be investigated.

**Sponsor:** POSCO

**PI/PD:** P.R. Pagilla

**Development of a Load-Based Method of Test for Light Commercial Unitary HVAC**

This project aims to develop a new method of testing for assessing the performance of advanced unitary equipment for light commercial HVAC applications. The PI will develop a new test protocol that measures a comprehensive energy performance figure of merit for advanced Roof Top Units versus its energy input at various outside conditions and at various indoor thermal loading conditions. The system energy efficiency enhancements due to economizer effectiveness, variable speed fans, fan cycling, variable speed compressor systems and condenser pre-cooling will be measured in a system level method of test as opposed to individual component level method of test.

**Sponsor:** American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

**PI/PD:** Lorenzo Cremaschi

**Surface and Airborne Monitoring Technology for Detecting Geologic Leakage in a CO2-Enhanced Oil Recovery Pilot, Anadarko Basin, Texas**

OSU, with the cooperation of the Southwest Regional Carbon Sequestration Partnership (SWP), will develop and implement new near-surface and airborne monitoring technologies. The research will focus on the design and deployment of a dense grid of shallow subsurface and surface sensors in combination with low-altitude airborne detection of CO2and CH4. These technologies will be deployed in the Farnsworth Oil Unit in the Anadarko Basin of the northeastern Texas panhandle, where the SWP and Chaparral Energy, LLC, are conducting CO2-enhanced oil recovery experiments.

**Sponsor:** Department of Energy

**PI/PDs:** Jamey Jacob, Girish Chowdhary

Chemical Engineering: Peter Clark

Civil Engineering: Tyler Ley

College of Arts & Sciences: Jack Pashin, Nicholas Materer

**UAV Integrated Power Management**

OSU will support Microlink in the development and feasibility demonstration of a small UAV that can operate as a perching micro air weapon. The air vehicle platform will incorporate Microlink’s energy harvesting system. The platform will utilize electric propulsion and advanced battery chemistries such as lithium polymer batteries for energy storage. OSU will provide technical and engineering services and support to facilitate testing of Microlink’s energy harvesting technology as applied to the air vehicle platform. This testing may include wind tunnel and simulated flight testing, testing and analysis of power management and allocation of all vehicle subsystems and components.

**Sponsor:** MicroLink Devices, Inc. for United States Air Force

**PI/PD:** Jamey D. Jacob

**Optimally Controlled Air-Conditioning Equipment for Sustainable Building Systems**

The objective of this project is to develop and deploy optimal supervisory and process control algorithms in all of AAON’s equipment. To achieve this goal a simulation testbed will be developed that merges a detailed physics based building model with a detailed, physics based vapor compression system model. This will allow development of both process and predictive supervisory control schemes that take into account such factors as building thermal mass and changing weather.

**Sponsors:** Oklahoma Center for the Advancement of Science and Technology, AAON Inc.

**PI/PDs:** D.E. Fisher, L. Cremaschi, J.D. Spitler

**Performance Analysis of HVAC Systems in the ASHRAE Headquarters Building**

In 2008, the ASHRAE Headquarters Building in Atlanta underwent major renovation. Of interest are the new HVAC systems, particularly a ground source heat pump system that serves the second floor and a variable refrigerant flow system that serves the first floor. In addition, a dedicated outdoor air system provides filtered and conditioned outdoor air to maintain indoor air quality. The objectives of this work are to compare the performance of the two heating/cooling systems, explain the reasons for the differences, and do this with sufficient rigor so that the comparisons and explanations can be published in peer reviewed literature.

**Sponsor:** The Geothermal Exchange Organization

**PI/PD:** Jeffrey D. Spitler

**OSU Support for REF Puma Endurance Solar Enhancement (PESE) Project**

This subcontract involves assisting Design Intelligence Incorporated, LLC (DII) in the design and development of “solar wing” upgrades for the Puma unmanned aerial vehicle. DII was awarded a subcontract from MicroLink Device, Inc. (MLD), to provide power-conditioning electronics and develop a new design and process for producing “solar wings” for the Puma using MLD’s proprietary flexible solar cell technology. As part of this effort, DII requires research and development assistance from OSU in the design and development of the wing molds, the new wing design, and development of the manufacturing and production processes required to produce wings.

**Sponsor:** Design Intelligence Incorporated, LLC

**PI/PD:** Jamey Jacob

**SNM: Roll-to-Roll Atomic/Molecular Layer Deposition**

The goal is to investigate and develop atomic/molecular layer deposition (ALD/MLD) processes for continuous production and to develop a roll-to-roll machine for ALD/MLD process which will enable thin-film growth on a flexible, moving substrate. The Colorado team will study the ALD/MLD processes which will be compatible for R2R manufacturing and the OSU team will design and develop a R2R machine for this process to conduct the experimentation in the project. The OSU team will build two R2R machines, one for experimentation at OSU and the other for experimentation at Colorado.

**Sponsor:** University of Colorado at Boulder for National Science Foundation

**PI/PD:** Prabhakar R. Pagilla

**Deployable Greenhouse for Food Production on Long-Duration Exploration Missions**

The project is to design, develop, build and test a deployable greenhouse system for the X-Hab

Academic Innovation Challenge. Goals of the project include the short-term goal of an

interdisciplinary senior design project to design, build and evaluate a horizontally oriented

habitat and a long-term goal to develop capabilities in education, research, and outreach in the field of space habitat design. This will include both technical engineering and outreach efforts. Faculty with diverse specialties from across the schools at OSU will participate in the project with the goal of developing technology and designs to facilitate human habitation in outer space.

**Sponsor:** National Space Grant Foundation for NASA

**PI/PDs:** Jamey D. Jacob

Architecture: Steve O’Hara

Industrial Engineering & Management: J. Cecil

Biosystems and Agricultural Engineering: Paul Weckler, Ning Wang

**Mechanisms of Hydration and Setting of Ordinary Portland Cement in Simple and Complex Systems**

For this proposal OSU will be responsible for completing laboratory scale micro X-ray computed tomography (mCT), focused beam X-ray Fluorescence (mXRF), and focused beam X-ray diffraction (mXRD) on Portland cement and combinations of Portland cement with mineral and chemical admixtures. In addition, several tests will be completed with these same techniques at synchrotrons facilities. The experiments will focus on investigating the change in the hydration of different clinker phases in different soak solutions that simulate the pore solution chemistry of hydrating Portland cement.

**Sponsor:** Trustees of Princeton University for the Federal Highway Administration

**PI/PDs:** Jay C. Hanan

Civil and Environmental Engineering: Tyler Ley

**Enhancing the Oklahoma Alliance for Manufacturing Excellence with Applications Engineers in Rural Areas**

The Applications Engineering Program works to increase the competitiveness of existing small and medium sized rural manufacturers by providing on-site, focused engineering assistance and technology transfer services. By placing a staff of engineers across the state, the program provides manufacturers with direct access to the latest in technology including access to the resources of Oklahoma State University’s engineering faculty. The program is a cooperative effort between the University and the Oklahoma Manufacturing Alliance.

**Sponsor:** Oklahoma Alliance for Manufacturing Excellence, Inc. for National Institute of Standards and Technology

**PI/PDs:** Daniel E. Fisher,

Division of Agricultural Sciences & Natural Resources: D. Thomas

**Subsurface Damage in IR Optics Materials – Year 3**

The approach will investigate the near surface state of a range of materials employed in IR optics applications. The PI will investigate damage created at the surface and near surface of polycrystalline ZnSe and ZnS (multi-spectral) that have been processed by traditional polishing, traditional diamond turning, and diamond turning using a fast tool servo. The depth and amount of damage, residual stress state, and changes in surface stoichiometry will be quantified. Investigations will also continue on single crystal SiC and single crystal Ge. In addition, chalcogenide glasses will be added to the materials to be investigated.

**Sponsor:** II-VI Foundation

**PI/PD:** Don A. Lucca

**Measurements of Pipe Insulation Thermal Conductivity**

Mechanical insulation systems are installed around cold pipes to limit the heat gain and to prevent moisture condensation on the pipe wall surface. Insulation jackets, vapor retarders, and vapor sealing of the joints and fittings are normally adopted to create a barrier to the moisture ingress into permeable insulation. However, experience shows that mechanical pipe insulation systems are not completely vapor tight and inevitably moisture accumulates in permeable insulation. This research involves measuring the thermal conductivity of six pipe insulation systems at below-ambient temperature and in wet condensing conditions with moisture ingress allowed into the insulation material.

**Sponsor:** American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

**PI/PD:** Lorenzo Cremaschi

**CAREER: Fundamental Studies on Ultrasonic Vibration Assisted Laser Surface Modification (UV-LSM) of Materials**

This project investigates basic phenomena associated with *ultrasonic vibration-assisted laser surface modifications* (UV-LSM) and advances this knowledge for engineering surface microstructures and properties of advanced materials. The central theme of this CAREER proposal is that the attenuation of ultrasonic vibrations in the melt pool created during laser-material interactions will induce microscopic (interdendritic) and macroscopic (within melt pool) hydrodynamic flows in the melt influencing subsequent microstructure evolution (grain refinement, homogeneity, and defect-free surfaces). The effect of ultrasonic vibrations on rapid solidification behavior will be investigated during three laser surface engineering approaches: Laser surface melting, laser composite surfacing, and laser surface densification.

**Sponsor:** National Science Foundation

**PI/PD:** Sandip P. Harimkar

**Revise Load Calculation Applications Manual**

It’s highly desirable that the LCAM (Load Calculation Applications Manual) incorporate new data and new procedures from recent ASHRAE (Application Manual for Non-Residential Load Calculations) research as well as be consistent with the Fundamentals Handbook. Accordingly, the primary objective of this project is to revise the LCAM and produce a second edition, in both IP and SI versions.

**Sponsor:** American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

**PI/PD:** Jeffrey D. Spitler

**Measurements of Oil Retention in Micro-channel Heat Exchangers**

This research focuses on measuring the volume of oil that is held up in microchannel heat exchangers adopted in systems for commercial refrigeration and air conditioning applications. The proposal represents experience in oil retention measurements for fin-and-tube heat exchangers. A refined test setup for injecting the lubricant into microchannel heat exchangers in a controlled fashion will be designed, built, and calibrated. Then, oil retention will be directly measured for microchannel heat exchangers working at different temperatures.

**Sponsor:** American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

**PI/PDs:** L.Cremaschi, D.E. Fisher

**Collaborative Research: Ion Irradiation-Induced Nanocrystallization of Metallic Glasses and Its Effects on Their Mechanical Properties**

Metallic glasses have superior hardness and high resistance to wear and corrosion, however they are generally brittle due to the absence of internal obstacles to arrest shear band propagation. The research objective of the proposed work is to develop an understanding of the mechanisms responsible for nanocrystal phase formation when metallic glasses are subjected to ion irradiation, and to quantify the resulting effects on the materials’ mechanical behavior.

**Sponsor:** National Science Foundation

**PI/PD:** D.A. Lucca

**Collaborative Research: Composite Surfacing of Amorphous Materials by Laser Interference Nanopatterning**

The research objective is to develop a new class of laser surface engineered amorphous materials characterized by enhanced ductility. The enhancement of the ductility of such amorphous materials is expected due to the formation of an array of periodic lines or spots of modified regions on the surface of amorphous material by laser interference nanopatterning. The regimes of laser interaction with amorphous materials will be selected such that periodic modified regions (lines or spots) will be characterized by localized nanocrystallization and/or residual compressive stresses. A Research Experiences for Undergraduates supplement received for this project supports research participation by undergraduate students.

**Sponsor:** National Science Foundation

**PI/PD:** Sandip Harimkar

**MRI: Acquisition of a High Performance Computer Cluster for Multidisciplinary Research**

Oklahoma State University High Performance Computing Center (OSUHPCC) will acquire, deploy and maintain an HPC cluster supercomputer, to be named Cowboy, that will support computing-intensive research and research training across a broad variety of Science, Technology, Engineering and Mathematics (STEM) disciplines. As a campus-wide shared resource, Cowboy will be available not only to all of OSU’s faculty, staff, postdocs, graduate students and undergraduates, but to researchers across Oklahoma.

**Sponsor:** National Science Foundation

**PI/PDs:** R. Singh

Electrical and Computer Engineering: S.A. Sohoni

Arts & Sciences: Dana Brunson, Lan Zhu

Division of Agricultural Sciences & Natural Resources: Peter Hoyt

**Comparison of the Energy Performance and Capacity of an Air Conditioning System that Uses Low GWP Refrigerants**

The overall scope of this research is to study the energy efficiency and cooling performance of an air conditioning (AC) system that uses new low GWP refrigerants manufactured by DuPont. OSU will conduct the performance tests in its large scale climate control chamber and will experimentally measure the energetic coefficient of performance (COP), cooling capacity, evaporator and condensers heat transfer capacity, and the refrigerant thermodynamic state points for the vapor compression cycle. A commercially available air-source AC system will be used in these experiments.

**Sponsor:** E.I. du Pont de Nemours and Company

**PI/PD:** Lorenzo Cremaschi

**Development, Optimization and Support of the EnergyPlus Central Plant Simulation**

This proposal includes a 5 year plan to provide critical support to a broad EnergyPlus program development effort led by Florida Solar Energy Center. The Oklahoma State University research team provides model development and implementation expertise in the EnergyPlus zone, system and central plant simulations. The proposal is organized by the following tasks: project management and maintenance, development and user support and training.

**Sponsor**: University of Central Florida for United States Department of Energy - National Renewable Energy Laboratory

**PI/PD:** Daniel E. Fisher

**Oklahoma Space Grant Consortium**

This project is supported by the Oklahoma Space Grant Consortium (OSGC), which has its headquarters at the University of Oklahoma. Congress authorized the National Space Grant College and Fellowship Program to develop and/or enhance university research infrastructure to support basic and applied NASA-related research and technology development. In 1991, NASA awarded the State of Oklahoma a grant for OSGC consisting of the University of Oklahoma, Langston University, Cameron University, and Oklahoma State University. Since then, more than $100,000 in fellowships has been awarded at these universities to promote the goals of the National Space Grant College and Fellowship Program.

**Sponsor:** University of Oklahoma for NASA

**PI/PD:** Andrew S. Arena, Jr.

**US-Germany Cooperative Research: M4 - High Resolution Surface Zone Analysis and Ion Beam Processing**

In previous phases of this research, the research team utilized a range of high resolution surface techniques to quantify the mechanical and chemical nature of newly developed mold coatings for use in optical component production. The team found that ion irradiation is an effective means to convert hybrid sol-gel films to their final hardened state. The project focuses on the use of high resolution surface zone techniques to aid in the development of new advanced mold coatings based on ion irradiated sol-gel films, and to enable the near surface mechanical and chemical characterization of both mold surfaces and optical components.

**Sponsor:** Foundation Institute for Materials Science IWT - STB/TR4

**PI/PD:** Don A. Lucca

**Web Transport Systems**

The objectives of this research are: 1) to expand the range of static and dynamic models in WTS to include models for new elements identified by sponsors, 2) to refine the models for viscoelastic effects and web-roller slip effects, 3) to develop new models for the precise control of tension in each section in a multi-span web transport system, and 4) to develop guidelines for selection of the control algorithms which best meet the defined performance objectives for a given application.

**Sponsor:** Web Handling Research Center

**PI/PDs:** Karl N. Reid

**Mechanical Behavior of a Web during Winding**

The objective of this project is to develop algorithms for wound-on-tension for various types of winding in which nips are involved in the winding configuration, to study varying nip winding conditions and parameters so that the mechanics of nip winding can be quantified and incorporated into winding and defect models, and to study and develop models for nip related defects.

**Sponsor:** Web Handling Center

**PI/PD:** Keith Good

**Web Wrinkling - Prediction and Failure Analysis**

Web quality degradation can occur if wrinkling takes place across the rollers or inside (or upon) wound rolls. This research is concerned with determining how wrinkles form as a function of web line and web material parameters.

**Sponsor:** Web Handling Center

**PI/PD:** Keith Good

**New Product Development Center**

**CaCl2 Prilling**

The project is a collaboration between Magnesium Products, Inc. (MagPro), the

New Products Development Center (NPDC) and OSU’s Department of Chemistry. MagPro has identified a market for crystallized, highly pure, pharmaceutical grade calcium chloride crystals, CaCl2. Since there are four primary chemistry combinations to evaluate, the laboratory scale processes will define the best candidate to scale up and take into production. Dr. Apblett

and his students will define the best process chemistry with assistance from the NPDC

Design Engineer. Together, they will define the process prototyping equipment and run the

preliminary experiments to determine which chemistry to utilize in scale-up.

**Sponsor:** Magnesium Products, Inc. for OCAST

**PI/PDs:** Robert Taylor

Arts & Sciences: Allen Apblet

**Safety Cabinet Next Generation Design**

Justrite Manufacturing Company, a leading producer of safety cabinets, is working with OSU to extend its product analysis and testing. The New Product Development Center (NPDC) and Fire Service Training (FST) at OSU will work with Justrite to engineer and test innovative concepts that will cement Justrite as the market leader in safety cabinet design and manufacture. NPDC and FST will provide modeling, analysis, and testing of new safety cabinet design concepts which will allow Justrite to meet and/or exceed the current legislative requirements and standards, as well as gain a competitive advantage in the marketplace.

**Sponsor:** Justrite Manufacturing Company, LLC

**PI/PDs:** Robert Taylor

Fire Service Training: Ed Kirtley

**Manufacturing Improvement Program for the Oil and Gas Industry Supply Chain and Marketing Cluster**

Comprehensive improvement in manufacturing requires a review of a manufacturer’s facilities, equipment, processes, product line, people, finances, markets and customers. The goal is to increase the innovation capacity and improve profitability of small- to medium-sized manufacturers in the oil and gas industry cluster. This will result in job creation in 44 low-income Oklahoma counties. Objectives are to help manufacturers 1) access current competency, 2) develop plans to reduce energy use and improve manufacturing processes, 3) innovate product lines, 4) train a diverse workforce, 5) manage financial consequences and outcomes, and 6) identify and meet the needs of customers and markets.

**Sponsors:** U.S. Department of Commerce Economic Development Administration, U.S. Department of Labor Employment and Training Administration, U.S. Department of Commerce National Institute of Standards and Technology, U.S. Small Business Administration, Department of Energy

**PI/PDs:** Robert Taylor

Division of Agricultural Sciences & Natural Resources: Daniel Tilley

**Oklahoma Inventors Assistance Service**

The Inventors’ Assistance Service (IAS) provides information, education, and assistance to Oklahoma inventors navigating the process of transitioning an idea into a product. The IAS offers workshops; maintains a website, a resource database, and a roster of contacts; offers informational materials; and offers general assistance to persons navigating the invention process. The IAS operates the Selected Inventions Program to organize inventor efforts to successfully bring an invention to the point where the process transitions to licensing, manufacturing, or recruitment of capital.

**Sponsor:** Oklahoma Center for the Advancement of Science and Technology

**PI/PDs:** Robert Taylor

Division of Agricultural Sciences & Natural Resources: Daniel Tilley

**Oklahoma Inventors Assistance Service (Tulsa Office Startup)**

This award establishes an Inventors Assistance Service/New Product Development Center office at the Helmerich Research Center in Tulsa, including hiring or transferring necessary staff, installation and setup of instrumentation, remodeling and preparation of laboratory space as needed, and setup and connection to communcations/computer systems as required for operation of the office. The office will provide assistance to inventors and small- and medium-sized manufacturers who want to develop new products and/or processes or who need help with invention and innovation processes, including patent applications, evaluation of competing technologies, market research, prototyping, and interactions leading to additional development and financing resources.

**Sponsor:** Oklahoma Center for the Advancement of Science and Technology

**PI/PD:** Robert Taylor

**Division of Engineering Technology (TECH)**

**Comparative Assessment of the Current Gross and Axle Truck Weight and Truck Permitting Laws in the United States and a Theoretical Analysis of the Infrastructure Impacts of Weight Exceptions that Allow Loads in Excess of the Gross and Axle Weight Limits Established by the Bridge Formula and the National Single Axle, Tandem Axle and Total Gross Vehicle Weight Limits**

The ODOT Senior Staff requires information regarding the impact of the increase in legal load limits on the Oklahoma Highway Infrastructure. Chief among their concerns are the impact of increased truck weight limits on the existing highway infrastructure, and what the costs to new projects, rehabilitation projects, and maintenance will be. There are also questions about what policies are in force in the contiguous United States with particular emphasis on the states adjacent to Oklahoma. The proposed investigation will respond to the needs of the ODOT Senior Staff by providing key answers to these questions.

**Sponsor:** Oklahoma Department of Transportation for the Federal Highway Administration

**PI/PDs:** Rachel Mosier

Civil and Environmental Engineering: Bruce Russell, Xiaoming Yang, Joshua Li, Kelvin Wang

University of Oklahoma: Jeffrey Volz, Dominique Pittenger

University of Tulsa: Jeremy Daily

**Cookshack Wood Pellet Appliances**

Cookshack, Inc. has requested this project from OSU to research the differences in wood pellet cooking appliances versus traditional solid fuel cooking appliances (i.e. charcoal, wood log, etc.). The client would like to determine if a Code modification proposal can be made to the NFPA 96 committee to modify the requirements to address wood pellet cooking appliances separate of traditional solid fuel cooking appliances. OSU investigators will: 1) review existing documentation of wood pellet cooking appliances, 2) review standards for the listing of wood pellet cooking appliances, 3) review the manufacturing process for cooking grade pellets, and 4) provide recommendations.

**Sponsor:** Cookshack, Inc.

**PI/PDs:** Virginia Charter, Qingsheng Wang

**Evacuation Simulations of Confined Spaces in Petrochemical Facilities**

Fire safety simulation tools, such as BuildingEXODUS and FDS+Evac, will be used to model emergency evacuations from typical confined spaces in petrochemical facilities. This project will demonstrate whether fire simulation tools can be applied to confined space evacuations in petrochemical facilities. It is difficult to perform experiments to conclude whether it is safe or dangerous for a potential confined space rescue. However, the simulation results will allow the investigator to determine the Required Safe Egress Time (REST) and the impact of different features and geometry for most process equipment.

**Sponsor:** University of Texas Health Science Center at Houston for CDC NIOSH

**PI/PD:** Qingsheng Wang

**Collaborative Research: Study of Flammability, Mechanism and Heat/Mass Transfer Associated with Burning of Flame Retardant Polymer Nanocomposites**

The objective is to understand the mechanism and to quantify the synergistic fire retardant effect of the nanofillers that form a physical barrier and the nanofillers that cause catalytic charring of the burning polymer. This will be achieved by studying the kinetics and the mass and heat transfer processes involved in the pyrolysis of the polymer with and without the nanofillers. The work is transformational because it will for the first time quantify the synergistic fire retardant effect of nanofillers in polymer nanocomposites.

**Sponsor:** National Science Foundation

**PI/PD:** Qingsheng Wang

**Emergency Egress Standards Film**

Although there are numerous emergency egress training videos, those videos focus on developing emergency evacuation plans. An educational film focusing on emergency egress building design strategies and hazard identification in accordance with the standards is not known to exist. A 45-minute film will be created as a learning resource to be integrated into undergraduate courses to educate students about the importance and content of documentary standards related to building egress. The film will be targeted to students in fire protection, architecture, and civil engineering; however, training on this topic would be applicable to workers and/or employers in almost any workplace.

**Sponsor:** U.S. Department of Commerce National Institute of Standards and Technology

**PI/PDs:** Bryan Hoskins

Architecture: Jeanne Homer