Tuskegee University recognizes the importance of external support of research and sponsored programs and the impact these vital programs have on the development of its students, faculty and society in general. Tuskegee University has a long-standing reputation of being among the nation’s premiere minority research institutions that are committed to total development of its students and faculty. From this annual report it’s evident that through our centers of excellence, academic colleges and other institutional units, our faculty, staff and students (both undergraduate and graduate) are engaged in research which is critical to address the needs of today’s citizens, industries and governments.

Since the creation of the Division of Research and Sponsored Programs in 1996, Tuskegee University has more than doubled its annual funding for research and other sponsored programs. The university concluded its year 2008-2009 with a total annual funding of approximately $41 million. Credit for this enormous success goes firstly to faculty members in the colleges and research centers, who in spite of heavy teaching loads and other responsibilities, continue to search for resources and write winning proposals. The staff members in the Division of Research and Sponsored Programs and various departments of Business and Fiscal Affairs are also to be commended for their enthusiastic support for the researchers in the grantsmanship process. These grants and contracts not only allow us to fulfill the research mission of Tuskegee University but also make a huge impact on our academic programs. Tuskegee University’s two Ph.D. programs in Materials Science and Engineering and Integrative Biosciences are prime examples of programs that are offered solely based on the expertise and resources faculty members develop.

Our long-term plan focuses on actively expanding Tuskegee University’s research in the areas of nano-biotechnology, information technology, environmental science and engineering, energy, sensors and devices, molecular biology, immunology, toxicology, public health, epidemiology, reproductive and environmental biology, and modeling and simulations.
Influence of Tumor Microenvironment on Prostate Cancer Progression

While great strides have been made in defining the molecular determinates of prostate cancer, the clinical management still remains a challenge. Prostate cancer metastasis is a multi-step processes wherein tumor cells acquire properties that enable them to detach, migrate, gain access to the circulatory system or lymphatic system, and disseminate throughout the body. The ability of the cancer cells to disseminate from the primary carcinoma mass requires a loosening of the cell-cell contacts. This is typically associated with the cell acquiring properties that drive the invasion and metastasis process. A hallmark of this process is the loss of tumor suppressor and cell adhesion molecule, E-cadherin. It has been further perceived that once loss of E-cadherin mediated cell adhesion is acquired, that this is maintained throughout metastasis. Recently, we have observed a reversal of these metastatic properties of the cancer cell by culturing the cancer cells with normal cells from the target metastatic organ. This results in re-expression of E-cadherin and a transformation of the cell to appear more like a normal cell. We also confirmed these findings in patients that have prostate cancer metastasis to the liver. Our reports are in line with clinical observations from other cancers that metastasized to the liver, including; breast, prostate, and colon cancers. This has lead to the hypothesis that cancer cell can change their shape and expression profile to adapt to different microenvironments. While prostate cancer metastasis is primarily to bone, liver and local lymph nodes; the surrounding cells (host microenvironment) are typically under-appreciated because cells in the tumor milieu are generally perceived only as silent bystanders. As we are just beginning to appreciate the role of the microenvironment during cancer progression: it is perceived that these changes are required for the cancer cell to successfully grow after metastasis to the target organ. Therefore, the interest of our laboratory is to determine the events that underlie our observed decreases in expression, of this once thought tumor suppressor E-cadherin, in the primary tumor and re-expression at the metastatic target site. As a consequence we are targeting intercellular adhesion molecule p120ctn and BTB/POZ zinc finger protein; Kaiso. Previous reports have shown the p120ctn is required to maintain E-cadherin at the cell surface; however a role for Kaiso in prostate cancer has not been defined. Therefore, we are proposing that the p120ctn-Kaiso signaling cascade is responsible for mediating signals from the cells surface to the nucleus to influence the function and expression of genes throughout progression; and that this is controlled by the tumor microenvironment. A likely reason these changes have been missed previously is a lack of appropriate assays to critical examine the dynamic signaling mechanism that is associated with this changes. As such we are employing a tissue engineering approach, utilizing three dimensional bioreactors that recreate physiological tissue, and allows for the real-time visualization of tumor growth and invasion. Through the use of this novel approach, we hope our findings will shed some light on the complex mechanism associated with cancer cells that have metastasized, and are growing in different organs. This will ultimately lead to new therapies that target not only the cancer cell, but also the surrounding normal cells that help the cancer cells survive.

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A Digital Forensics Infrastructure

While the field of digital forensics is relatively new within computing sciences and justice programs and has many research challenges associated with it, practitioners are applying the limited tool sets available today in civil, criminal and private investigations. The field of digital forensics presents a rare opportunity to conduct leading edge research alongside those who practice the science in their daily jobs. This NSF supported grant allows researchers an opportunity to perform empirically based research and to validate their work in a real environment.

This implementation of the Digital Forensics Cyber Infrastructure brings the faculty members in the Department of Computer Science at Tuskegee University together with collaborators at Mississippi State University and Auburn University to conduct research, develop curriculum and provide tactical level occupational training in digital forensics.

**Research Component**

Research projects that offer ample opportunities for undergraduate students to conduct intensive research in digital forensics, including in the small scale digital device forensics at Tuskegee University were designed. Through participating in these programs, students in Computer Science are exposed to some forensics tools and technological underpinnings in the fields of digital forensics. They are directly and closely supervised by the PI and Co-PIs. In addition, experiments designed in the digital forensics laboratory offer undergraduate students opportunities to gain hands-on experiences in implementing and evaluating digital forensic tools.

Three projects are proposed for the students to conduct research. The first project involves analysis and evaluation of current forensics tools and the development of specialized toolkit. The second project includes investigation of General-Purpose Graphics Processing Units (GPGPUs), development of a toolkit for digital forensics using GPGPUs, and the performance evaluations in data carving and string searching algorithms running on CPUs and GPGPUs. The final project comprises the research of debuggers and software development kits for mobile devices, such as cell phones and Personal Device Assistances (PDAs), the development and the assessment of toolkits based on the debuggers and SDK for mobile devices. To assure high quality student research, the PI and Co-PIs are evaluating the performance and effectiveness of the proposed projects. Our results will be disseminated via publication in relevant journals, conferences and workshops; and distribution of our software development kits for use by other researchers.

**Education Component**

Two digital forensics courses have been developed under the support of this NSF grant: Computer Forensics and Small Scale Digital Device Forensics. The first course introduces fundamentals of computer forensics and cyber-crime scene analysis including laws, regulations, and international standards. It takes a detailed hands-on approach to the investigation of incidents in which computers or computer technology play a significant or interesting role. The second course focuses on small scale digital device forensics. The issues, techniques and vulnerabilities of small scale digital device forensics are discussed. Forensically sound acquisition, preservation, analysis and presentation of small-scale digital devices as evidence will be the focus of the course. A computer forensics laboratory that consists of state-of-the-art computers and various forensics hardware/software was established to support related courses and research.

**Outreach Component**

The grant addresses a recognized and documented workforce need for skilled cyber infrastructure employees and offers to address this need by training a diverse community, America’s veterans, by collaborating with the U.S. Department of Veterans Affairs (VA) and offering no-cost training at or near VA hospitals. The training we offer through Veterans Administration facilities will give priority to disabled veterans in attempting to assist them in career retraining. Priority will also be given to minorities (ethnic and female) in this program. By doing so, the PIs expect to increase the number of minorities graduating with expertise in digital forensics and cyber security. Through our training of veterans, we collectively expect to assist in partially addressing the skill shortages for skilled cyberinfrastructure workers. Under this grant, we will also conduct one week summer camps for grades 7-12 in 2010 and 2011 to boost students’ interest in the area of digital forensics and cyber security.

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The Alabama Center for Nanostructured Materials (ACNM)

Tuskegee University’s Center for Advanced Materials (T-CAM), which is the largest multidisciplinary research and educational center, houses several centers of excellence including the ACNM. Currently, the focus of T-CAM is on the development and characterization of nano and biomaterials. The center supports at least 50 students, undergraduate through the doctorate, representing eight STEM disciplines. Tuskegee University’s first Ph.D. Program in Materials Science and Engineering (Ph.D./MSE) is also spearheaded and fully supported by this center. To date, Tuskegee University has produced 14 graduates with Ph.D./MSE and an additional six are expected to graduate in 2010.

ACNM is a multi-institutional center of excellence funded by National Science Foundation – EPSCoR program involving six universities with Tuskegee as the lead institution.

Polymeric nanocomposites: In this work, structure-processing-property relations of thermosetting polymers with functionalized carbon nanotubes are being studied. In addition to these studies, research tasks are being carried out that will establish, experimentally and theoretically, the relationships of electrical/thermal properties to nanoparticle dispersion state in nanocomposites. At the macro level, we are developing carbon/carbon nanocomposites for high temperature applications. Structural nanocomposites with glass and carbon fabrics and nanophased epoxy are fabricated and characterized for their durability aspects. Study of the response to dynamic loading like high strain rate and high velocity impact through experimental and finite element approaches is being carried out.

Magnetic Nanoparticles for Drug Delivery: In the quest for identifying and implanting methods to improved drug efficiency for both patient convenience and more effective therapeutic uses, novel areas of research are being explored and developed. Drug targeting tumors or cancerous regions are especially needed due to the nonspecific toxicities exhibited by anti-cancer drugs that limit their use. Magnetic nanoparticles used in bio-related applications are the result of a new class of magnetic materials called nanobiomagnets. Nanomagnets have a promising future in biomedical applications due to their size compatibility with cells, viruses, and genes. Because iron is naturally found within the body, it is an ideal candidate for in vivo magnetic applications. In this project, we are synthesizing and characterizing iron, iron carbide and/or iron oxide nanoparticles from sonochemical techniques using organometallics as the primary precursor. Magnetic properties, drug delivery and toxicology studies are being conducted in collaboration with researchers at Auburn and Alabama State universities.

Advanced Green Composites: In recent years, demand for green composites has increased due to the increased concerns about energy conservation combined with newer legislative laws relating to the proper disposal of composites and other related materials. In addition to the environmental benefits, green composites are just as capable of producing materials of comparable strength and toughness as other non-environmentally friendly materials. Under this project, we are developing a kenaf reinforced soybean oil biocomposite as well as banana fiber reinforced green composite. In another study, we are extracting cellulose nanofibers such as cotton, flax, hemp, jute, and sisal by acid treatment, disperse them in polymers, prepare prepregs, mold them into composites and then characterize them for their mechanical properties. We are also investigating the processing techniques for manufacturing multifunctional cellulose nanocomposite fibers. In this work, dispersion of magnetite nanoparticles is being investigated.
NUCOR –Education and Research Center (NERC)

The Nucor Center of Excellence at Tuskegee University is comprised of three main components: Education, Research and Outreach. It provides engineering graduates with basic and applied knowledge of steels and their related technologies.

Educational Component
This involves the development and implantation of several courseware modules, short courses and technical seminars. These modules can be integrated into graduate and undergraduate courses. These courses will be taught as technical electives.

Research Component of the program is designed to stimulate the awareness, interest, excitement and confidence of outstanding, undergraduate students in real-world industries such as steel manufacturing and lead them into careers in metallurgy and emerging steel processing technologies. Research topics include:

- Heat treatment effects on the impact fracture toughness of steels and their alloys
- Microstructure- properties relationship of structural steels
- Processing- properties relationships of structure steels
- Analysis of surface defects in hot and cold rolled steels.
- Accelerated corrosion studies on enameled and galvanized steels.
- Improvement of wear, strength and corrosion resistance of steels using nanocoatings.

Tuskegee University has built strong capabilities and infrastructure to address these research activities. This includes the acquisition of optical, scanning electron, and atomic force microscopes, servo-hydraulics and electro-mechanical materials testing systems, equipment for corrosion and heat treatment studies, nondestructive imaging systems, X-ray photoelectron spectroscopy and secondary ion mass spectrometry findings. The report should be of high quality to enable the student to earn three credit hours towards his/her engineering degree. An oral presentation is also required with the participation of NUCOR representatives. Research findings will also be submitted to refereed journals.

Leveraging of Resources
In addition to the major funding provided by NUCOR, synergistic research activities funded by the Federal Railroad Administration, Missile defense agencies, and John Deere, are leveraged to provide extra resources for the center.

Outreach Component
Local middle and high school students through linkage and outreach programs will participate in key research and applied activities. The objective is to develop a culture of knowledge and awareness among students with a focus on emerging areas of steels and their technologies. The center will partner with the Alabama Math, Science and Technology Education Coalition (AMSTEC) to reach out to K-12 institutions throughout the state of Alabama.

Assessment
Participating students are required to submit a final report outlining the student's research and/or design

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Building a Coalition in Southern Black Belt States for an Inclusive Asset Building Policy and Program Agenda: Focus on Victims of Hurricanes, Persistent Poverty, and Black-Owned Land Loss

Funded by the Ford Foundation, this project has become a major external resource under the Continuing Education and Cooperative Extension Program, but has a background that also includes the College of Agricultural, Environmental, and Natural Sciences in general, and colleagues Robert Zabawa and Alice Paris, in particular. It has culminated in the development of a Southern Asset Building Coalition (SRABC) which can be traced back to the early 1990s when the Professional Agricultural Workers Conference (PAWC) recognized the need for a more applied research and policy focused approach to addressing the socioeconomic conditions in the Southern Black Belt Region of the United States. From this effort emerged the Southern Foods System and Education Consortium (SOFSEC) of 1890 Universities and Community-Based Organizations, with support from the W. K. Kellogg Foundation. By 2003, this consortium had brought academic and community partners together to explore and propose a congressionally mandated Southern Black Belt Region Commission.

The Ford Foundation had also initiated a special effort through strategy meetings at Tuskegee University and throughout the nation to mobilize scholars and experts of color to address the racial wealth-gap. The first opportunity for TU to be a part of this effort occurred in 2006 in response to the challenges of families recovering from Katrina, Rita and other natural disasters, as well as the ongoing phenomena of Black-owned land loss. Tuskegee University, with the help of the Center of Social Development at Washington University-Saint Louis, took the lead to bring together a number of partners including Florida A&M University, the Federation of Southern Cooperatives, the Florida Family Network, the Mississippi Association of Cooperatives, and the Alabama Arise Citizens’ Policy Project.

Meetings were convened in several venues throughout the four participating states. The overall goal of each meeting was to disseminate information and raise awareness on asset building initiatives, policies, and trends, while building partnerships that supported the development of state and regional coalitions.

The meeting in Gulfport, Miss., on Feb. 10-12, 2008, focused on the need to develop a regional coalition with expanded research and resource capacity to support state coalitions.

As the regional coalition has become more operational, the partners decided to adopt the name—Southern Regional Asset-Building Coalition (SRABC), which seeks to empower families and communities by developing and sustaining assets that they can leverage to ensure stability and independence in their lives. Its mission is to build and support policy efforts that encourage asset building in the Black Belt and Gulf South states through education, research, and advocacy using a regional coalition that supports state-based coalitions and community efforts. The work of the Southern Regional Asset-building Coalition will emphasize the following strategies: (1) strengthen regional and asset building coalitions and networks in the Black Belt and Gulf South regions; (2) design and develop effective communication systems and tools, including an enhanced Web site and clearinghouse; (3) expand the capacity of community-based, university, and policy partners with vested interests to promote asset ownership, protection, and preservation among the working-poor and minority communities; (4) develop educational, legal, and other services relevant for asset building-based economic development within the state and regional coalitions and networks; and (5) connect organizations working on land loss and ownership issues in the region to asset-building efforts.

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One Medicine, One Health, One World

Research, as one of the tripartite missions of education, research and service plays a central role in the strategic advancement of the CVMNAH. Dr. Tsegaye Habtemariam, DVM, Ph.D., who carries an active research program in epidemiologic modeling, serves as Dean of the CVMNAH. Dr. Cesar Fermin, Associate Dean for Research and Advanced Studies (ADRAS), coordinates the development of basic, clinical and applied research as well as degree and non-degree graduate education. For additional information: http://www.onemedicine.tuskegee.edu/ADRAS/home.htm.

The unique area of strength of the CVMNAH amongst many is its commitment to promoting the One Medicine, One Health and One World universal concept. This framework brings the unity of health in peoples, animals and the ecosystem that we share. Current H1N1, or swine flu is creating havoc across our campuses and all over the world. H1N1, the bird flu virus, the HIV/AIDS virus, BSE, prions and other originate in animals and often jump species to affect humans. They are responsible for world-wide epidemics referred to as pandemics. This fact underscores the need to integratively look at health across the spectrum of populations and the environment that we share. The CVMNAH is uniquely configured and committed to this One Medicine One Health concept. It is also via that framework that we are committed to focus upon studies that address health disparities in the rural, underserved populations of the black belt counties of Alabama.

The areas of strategic biomedical research are: 1) Health Disparity research with emphasis on cancer and HIV/AIDS, 2) Molecular level studies of male reproduction, 3) Molecular studies of zoonotic infectious diseases with emphasis on food safety, and 4) Obesity and food intake with potential impact on diabetes.

Scientists in the College are exploring molecular analyses of cultured cancer cells exposed to extracts from medicinal plants known to effectively influence diseases in humans and animals. The strategy is to determine at the cellular (phenotype) and molecular and biochemical (functional) levels what changes occur when cultured cells are exposed to a particular extract. At left cells unexposed (A) and exposed to an extract (B) show differing number of proteins loci suggesting a change in synthesis. This type of research my help to identify cellular pathways that are modulated by diet and drugs that could lead to beneficial or harmful interactions in humans and animals.

Other studies by the CVMNAH molecular team suggest that Y. pestis the causative agent of plague and food borne pathogens, Y. enterocolitica and Y. pseudotuberculosis survive under standard storage conditions. Yersinia survives and grows in milk and orange juice; suggesting it is a potential hazard for Yersiniosis in accidental or intentional contamination in foods. Data on genetic response and tolerance of these organisms was obtained using multi-locus sequence alignment combined with promoter proximity to region of selected genes that play functional roles in environmental adaptation and potential pathogenicity is being collected. These data allow teasing the genomic control of processes that render pathogens capable of surviving extreme conditions.

In another area, investigators pursue physiological mysteries behind control of individual meal size (satiation), asking what controls the length of time between meals, or the intermeal interval (satiety). Other researchers are actively involved in computational modeling of diseases, bioinformatics and risk analysis as well as molecular level studies of male reproduction, cardiovascular diseases, toxicity and diabetes.

Tsegaye HabteMarian, Ph.D., DVM, MPVM.
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Enhanced Communication and Collaboration among Undergraduate STEM Disciplines

Tuskegee University is the first recipient of the highly competitive NSF grant under the HBCU-UP Phase III program. This grant is designed to foster a dramatic paradigm-shift from traditional lectures to discovery-based teaching, hypothesis-driven project labs, and instructional synergy to build a cohort of students prepared to thrive in the 21st century STEM workforce which increasingly requires computational and quantitative proficiency. This overarching goal will be buttressed by the following programmatic activities: (1) Curricular Development, Revision and Enhancement Reform; (2) Research Experiences for Undergraduates, Student Support and Enrichment Activities; and (3) Faculty Development. In this regard, ACE draws upon the complementary strengths of Tuskegee’s STEM departments to devise a highly integrated and collaborative science curriculum. Highest priority is given to aligning the science curricula to ensure that theory, theme and concepts are echoed across the first- and second-year sequence in biology, math, computer science, chemistry, and physics to prepare students for the rigor of a concentration in either biophysics or quantitative genomics. For example, BIOL305 Anatomy and Physiology course material on the cardiopulmonary system is reinforced by material on fluid dynamics from aerospace engineering and physics. More importantly, the fluid dynamics chapters in the newly designed PHYS 301 Physics for Life Sciences course is embedded with references to the cardiopulmonary system. Therefore, faculty professional development initiatives are designed to ensure effective deployment of the integrative science curricula infused with technology and authentic research; and development of an innovative collaborator research experience that will engage all science majors in authentic research as early as their first year.

Engagement in the research process is no longer viewed simply as complementary to the education process, but inextricably linked to high quality STEM training in the 21st century. Pivotal to the success of the ACE program is the translation of the excitement of research to students at the earliest points of their undergraduate training. The research enterprise at Tuskegee almost invariably focuses on addressing health disparities in communities of color. Hypertension, diabetes, prostate and breast cancer basic research comprise an appealing constellation of research thrusts to which our undergraduates are strongly attracted. We exploit this interest to migrate STEM students into research in an innovative way that deepens in intensity with each year in their undergraduate program.

The ACE program is anchored in the Biology Department which is under the leadership of Dr. Danielle N. Gray-Singh, who also serves as the ACE Director. Biology is the largest major on the campus and is uniquely positioned to: (a) erode (or blur) the boundaries between STEM disciplines as biology has become heavily dependent on mathematics and computers to solve its questions and (b) to populate Tuskegee’s first interdepartmental, interdisciplinary concentrations in Biophysics/Bioengineering and Quantitative Genomics. It serves more than 1200 students and provides research incentives to 20 faculty members across Aerospace Engineering, Biology, Chemistry, Computer Science, Math, Physics, and Psychology.

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The CBR, supported by a grant by the NIH’s Research in Minority Institutions (RCMI) program serves as the cornerstone for biomedical research at Tuskegee University. The Project Director (PD) is Dr. Cesar Fermin, Associate Dean for Research and Advanced Studies and the Principal Investigator (PI) is Dr. Tsegaye Habtemariam, Dean. Both are from the College of Veterinary Medicine, Nursing and Allied Health (CVMNAH). The CBR represents a core institutional infrastructure, which when taken in combination with a high quality human resource base, is vital for the implementation and maintenance of a state of the art biomedical research enterprise. The overarching but complimentary goals of the CBR are: a) to support and promote the newly created Ph.D. program in Integrative Biosciences (IBS) and, b) to focus biomedical research upon two of the health disparity diseases that includes cancer and autoimmune diseases (specifically HIV/AIDS and lupus).

The CBR builds upon a vision of studying health-related problems through the use of in-vivo, in-vitro and computational models. These interrelated modeling approaches provide powerful alternatives in advancing biomedical research. A laboratory animal facility provides in-vivo animal models for advancing research.

To further strengthen the CBR, new faculty with expertise in molecular biology, research on cancer, HIV/AIDS and lupus as well as bioinformatics and computer modeling has been recruited. These strategic activities seek to interrelate research in animal health with human health via the One Medicine One Health framework.

CBR scientists partner internally with the new Center for Bioethics in Research and Health Care (NCBRH) at Tuskegee, which promises new avenues for innovative research with ethics at its core. The center utilizes a multidisciplinary, community-based approach to examine and articulate issues in health care research and delivery and public policy involving and affecting African-Americans and other vulnerable populations. External partners include University of Alabama, (Birmingham and Tuscaloosa), private and government agencies.

Information Sharing: Beginning in 1997, using RCMI funds and other resources, an Annual Biomedical Research Symposia highlights health issues that disproportionately affect humans in the Black Belt counties of Alabama and other areas. Biomedical research results are shared nationally and globally via presentations given in China, India and Africa, to name a few. CBR Scientists published or submitted 44 journal articles, 66 abstracts and three 3 books/chapters.

Detailed information about the CBR is found at this link: http://www.onemedicine.tuskegee.edu/RCMI/Index.htm.
Small Business Innovative Research (SBIR) and Small Technology Transfer Research (STTR) Programs

The SBIR program, which is funded by the National Science Foundation, Department of Defense and other federal agencies, is designed to stimulate technological innovation at minority and disadvantaged firms in the United States. The program consists of three phases. Under Phase I, funds up to $100,000 are provided for a shorter duration (6-12 months) to develop and test the scientific, technical, and commercial merit and feasibility of a particular concept. After the successful completion of phase I, the company may be invited to apply for a two-year Phase II award of up to $750,000 to further develop the concept, usually to the prototype stage. A university may be included as a sub contractor. Following completion of phase II, the companies are expected to obtain funding from the private sector and/or non-SBIR government sources (in “phase III”) to develop the concept into a product for sale in private or government sectors. The STTR, which is similar in structure to SBIR, funds cooperative R&D projects involving a small business and a research institution. The purpose of STTR is to create an effective vehicle for moving ideas from research institutions to the market place. A university may be the leading partner in a STTR proposal. Tuskegee University faculty partner with several small businesses through these contracts.

Some of the SBIR/TTR contracts that have been successfully completed in recent years are:

TU PI: Dr. Vijay Rangari

“Role of Nitrogen on Nanocrystalline Diamond Nucleation and Growth; Cutting tool applications.” Prime contractor: Vista Engineering, Birmingham, Ala.
SBIR Phase II, TU PI: Drs. Rangari and Jeelani


Current SBIR/STTR Phase II Contracts

Under a STTR phase II contract from Johnson Research, Atlanta, GA, under the title “Johnson Thermo-electrochemical Converter as a solar Powered Engine,” Dr. Heshmat Aglan is developing and characterizing hybrid Membrane Electrode Assemblies (MEA) supported by nanotechnology. High performance nanostructured polymeric thin films are formulated at Tuskegee to constitute the MEA stacks which are critical components in a solar powered engine. Several different approaches are being tested, including impregnating polymers with an organic precursor mixture for the desired inorganic electrolyte solution and casting or spin coating the nanostructured polymeric solutions to manufacture the electrolyte thin films. Since the MEA consists of two electrodes and an electrolyte sandwiched between the electrodes, graphite electrodes will be formulated and deposited on the electrolyte thin films. Completed MEA will be fully characterized both mechanically and electrically.

Under a Phase II contract from Performance Polymer Solutions Inc (P2SI) Moraine, OH, Dr. Vijay Rangari is developing Innovative isotropic ultra-high thermal conductivity diamond materials. He is specially investigating the optimization of the CVD process to deposit carbon nanotubes on graphite host surfaces. He will also conduct high resolution TEM analysis of the NF2-M substrates provided by P2SI to identify the mechanisms for strength reduction and the fundamentals underlying CVD process that give rise to the strength reduction. Tuskegee’s processing, thermal analysis and microscopy capabilities are very useful for these tasks, which require quick turnaround.
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