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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 committed to the total development of its students and faculty. In this annual report, it is evident that through our centers of excellence and academic units, our faculty, staff and students are engaged in research that is critical to address the needs of today's citizens, industries and governments.

Since its creation in 1996, the Division of Research and Sponsored Programs has more than doubled the annual funding for research and other sponsored programs at Tuskegee University. The university concluded the fiscal year 2010-2011 with a total annual funding of $47.6 million for support of its research and sponsored programs, which represents an increase of 16 percent over the last year. Credit for this enormous success goes to faculty members, who 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 of 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 a52ationotsmanthenu6mmendsmanthenfairsl8oE(uskegeonotsmay vwohe r)18(esePh.D
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It is generally known that the North American and the African continents face some of the most serious water and environmental challenges that are further complicated by climate change issues and uncontrolled anthropogenic pollution from human activities. For example, various technical studies, including reports by the African Ministers Council on Water (AMCOW), have indicated that Africa is one of the most vulnerable continents to environmental and climate change impacts, to the extent that previous development efforts and the millennium development goals (MDGs) are in jeopardy. The arid and semi-arid regions in Africa and North America are becoming drier, while some areas of equatorial Africa and parts of southern Africa are getting wetter, thus leading to serious drought in some areas and flood problems in others. The current severe drought and famine situation in Somalia and the Horn of Africa is instructive. Global warming, resulting from green-house gas pollution, is believed to have also played a major role in climate change and higher temperatures throughout much of North America and Africa.

This project, funded under the USAID "Africa-US Higher Education Initiative", is an international partnership with Tuskegee University, the lead institution, and Princeton University together with four universities from three African countries as project partners. The International Institute for Water and Environmental Engineering (2iE) in Burkina Faso is the lead institution in Africa while the University of Mines and Technology

**PRINCIPAL INVESTIGATOR:** Shaik Jeelani
**CO-PRINCIPAL INVESTIGATORS:** Mahesh Hosur and Pradosh Ray (Tuskegee), Lynden Archer and Melissa Hines (Cornell)
**OTHER PARTICIPANTS:** Melissa Reeves and Tamara Floyd Smith

A long-term partnership for research and education in nanomaterials, between the Center for Advanced Materials (T-CAM) at Tuskegee University (TU) and the Materials Research Science and Engineering Center (MRSEC) at Cornell University has been established, under the Partnership for Research and Education (PREM) program, sponsored by the Division of Materials Research at the National Science Foundation (NSF).

This partnership is based on a very productive relationship TU had with Cornell for many years. This relationship had a significant impact on the development of the materials science and engineering (MSE) program at TU. Recent interactions between Tuskegee and Cornell were through two NSF grants to TU, under the Center for Research Excellence in Science and Technology (CREST) and the Nanoscale Interdisciplinary Research Teams (NIRT) programs. Through these grants, the Tuskegee and the Cornell faculty have jointly investigated the effects of modifications to the surface of the nano reinforcements on the interfacial properties of nanocomposites and also studied the influence of geometry of nanosized objects on their response to external fields.

Under the current grant, Tuskegee-Cornell PREM team has focused on the following specific research tasks:

### 1) Synthesis and Characterization of Cubic Cobalt Oxide Nanocomposites:

Cubic cobalt oxide nanocomposite system is of interest because suspensions of cubes are expected to exhibit enhancements over traditional spherical particles for applications such as liquid body armor as it would achieve shear thickening behavior at a lower shear rate when compared with spherical nanoparticles. In order to maintain long-term stability (> 30 days) of this system for armor application, studies of the intrinsic viscosity of the system with and without poly vinyl pyrrolidone (PVP) have been conducted and estimated it to be ≈5.03. Rheological behavior of this system depends on the viscosity being studied.

### 2) Surface Chemical Investigations of Inorganic Guest-Organic Host Binding

Under this task, studies on the effect of silicon carbide (ß-SiC) nanoparticles (~30nm) sonochemical coating on silicon dioxide (~ 200nm) nanoparticles and infused into SC-15 epoxy resin to increase the thermal and mechanical properties of SC-15 epoxy for structural applications has also been conducted. In order to increase the SiC binding with the polymers, sonochemically coated SiC nanoparticles by three types of polyhedral oligomereic silsesquioxane (POSS) namely: Octalsobutyl (OI), EpoxyCyclohexyl (EC) and GlycidylEthyl (GE) POSS. XPS (X-ray Photoelectron Spectroscopy) analyses were carried out to explore the chemical composition and surface characters of SiC nanoparticles and POSS coated SiC nanoparticles

### 3) Studies on the effect of functionalization on the morphology, cure kinetics, multifunctional properties, and fracture behavior of MWCNTs with thermosetting polymers.

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This is an integrated project to initiate teaching, research and extension in aquatic animal health. The teaching part of the project is being developed by Dr. Srivastava with assistance from the collaborator, Dr. Joseph C. Newton, Associate Professor, Department of Pathobiology, College of Veterinary Medicine, Auburn University, Auburn, Ala. The research part is being conducted in collaboration with Dr. Gopal Reddy and the two USDA scientists, Dr. Phillip H. Klesius and Dr. Julia W. Pridgeon of the Aquatic Animal Health Research Laboratory, Auburn, Ala. The Extension part including the long distance learning, delivery and teleconferencing part of the project is being conducted by Dr. Cesar D. Fermin. This integrated project allows us to develop an aquatic animal health laboratory at College of Veterinary Medicine, Nursing and Allied Health (CVMNAH). This integrated project is expected to strengthen undergraduate, professional and graduate curricula and provide research projects for graduate students interested in aquatic animal health. The long distance learning, delivery and teleconferencing methods are likely to facilitate the development of a novel framework for tracking bacterial fish diseases, and help us in our attempts for preventing, and controlling these diseases. The research laboratory in aquatic animal health will help us to develop state-of-the-art diagnostic techniques where fish diseases could be readily identified. Information about the diseases identified in this laboratory could be quickly delivered via teleconferencing to all Alabama as well as regional fish farmers.

The project will help in recruiting and retaining quality students and will boost the aquatic animal health laboratory resources. Tuskegee University faculty will be exposed to state-of-the-art fish disease diagnostic techniques and will be able to undertake such experiments on their own when needed.

This project will help in developing and strengthening veterinary and graduate education in and aquatic animal health that may have great potential for careers for Tuskegee students. An infrastructure built upon aquatic animal health's biotechnological advances in the identified specialties within the Department of Pathobiology is critical in the Tuskegee University's strategic plan to prepare for the challenges of the second decade of the 21st century.

Specifically, this project will enhance research as well as teaching infrastructure in the Department of Pathobiology in the

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**PRINCIPAL INVESTIGATOR:** Li Jiang
**CO-PRINCIPAL INVESTIGATORS:** Kalyan Kumar Das and Michael A. Awaah

The Microelectronics Laboratory at the Department of Electrical Engineering, Tuskegee University, was established in 1998 with support from a Department of Defense (DoD) Infrastructure Development grant. The laboratory is housed in a class 1,000 clean room. Until recently, facilities included several photoresist processing tools, a Karl Suss MJB3 mask aligner, and an AJA International Orion 5 sputtering system. In 2010, we were awarded an NSF Major Research Instrumentation **(MRI)** grant that was utilized to acquire several semiconductor measurement and

**PRINCIPAL INVESTIGATOR:** Jacquelyn R. Jackson
**CO-PRINCIPAL INVESTIGATORS:** Marceline Egnin-Tuskegee University and Aurelie Rakotondrafara- University of Wisconsin-Madison

Plants are constantly exposed to a broad spectrum of pathogens. To defend themselves, plants have developed a sophisticated immune system that allows them to recognize the invader and turn on an appropriate defense response. Understanding the molecular basis of innate resistance mechanisms in plants is of very high priority and is necessary for forwarding efforts to protect our global food supply.

Tuskegee University and the University of Wisconsin-Madison have come together to address this issue in a three-year project, jointly funded by USDA's 1890 Capacity Building Grant Program. The project aims to uncover novel resistance gene analogues (RGAs) from select varieties of sweet potato and explore potential sequence polymorphisms of genes predicted as viral resistance determinants. Nucleotide Binding Site (NBS) profiling of resistance gene analogues (RGAs) in the sweet potato transcriptome serves as a powerful tool in facilitating the cloning of disease resistance genes that can be engineered into desirable cultivars. The objectives of the project are:

1) To isolate putatively functional resistance gene analogues (RGAs) from different cultivars of sweet potato and characterize RGA sequences. The complexity of sweet potato's hexaploid genome has made breeding for resistance extremely difficult, therefore using Nucleotide Binding Site (NBS) profiling to isolate resistance genes in sweet potato will greatly assist with efficiently generating large collections of putatively functional R-gene and RGA fragments.

2) To analyze sequence polymorphisms in the host translation initiation factor, eIF4E, and its isoform homologues in different sweet potato cultivars and determine the relevance of eIF4E resistance to SPFMV. Despite correlations that have been established in other crops pointing to the importance of eIF4E as a recessive resistance gene against potyviruses, no study has investigated the relevance of eIF4E as a resistance determinant in sweet potato.

3) To determine the relevance of the interaction of the eIF4E/eIFiso4E and the viral protein bound to the genome, VPg, in sweet potato potyviral infections as an exploitable means of resistance Closely examining the interaction of eIF4E with the VPg of potyviruses will aid in understanding the role of eIF4E-encoding resistance genes in p
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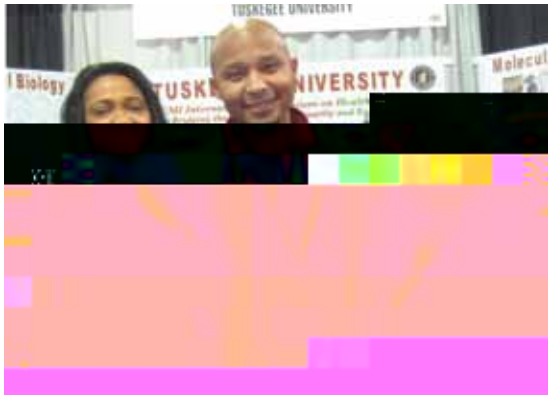
**PRINCIPAL INVESTIGATOR:** Tsegaye Habtemariam
**CO-PRINCIPAL INVESTIGATOR/DIRECTOR:** Cesar Fermin



The functions of the TU-RCMI are fulfilled through the development of several core services and three pilot projects headed by promising bright junior investigators working in cancer and autoimmune diseases (specifically HIV/AIDS and lupus). Dr. Clayton Yates pictured above (Middle) with D. Hall (Right) and C. Davis (Left) is one of the junior stars supported by RCMI funds to work in cancer. RCMI faculty such as Drs. Yates, Martinez, and Tameru are required to make a transition from dependent to independent research by securing R type or equivalent funds to support future research. Hall is a member of the CBR internal advisory committee and also director of the Office of Sponsored Programs, now institutionalized after initial support from previous RCMI grants.

Tuskegee University is one of 18 HBCU members with support from the RCMI program. The overarching but complementary 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 include cancer and autoimmune diseases (specifically HIV/AIDS and lupus).

Policies and regulations for RCMI programs are administered by a PI/PD organization that meets twice a year with NIH officers to keep the programs on track.

Pictured below are NIH officers and PI/PD members at the 2010 annual meeting that took place in Nashville with Meharry Medical College, Morehouse School of Medicine and Tuskegee University as sponsoring institutions.

The CBR is supported by a grant from the NIH's Research in Minority Institutions (RCMI) program that was renewed in 2010 for a five- year cycle. The program serves as the cornerstone for biomedical research at Tuskegee University. The Principal Investigator (PI) and the Project Director (PD) during the year 2010-2011 were Drs. Tsegaye Habtemariam and Cesar Fermin, respectively.

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 scientists partner internally with the new Center for Bioethics in Research and Health Care (NCBRH) at the university, 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.

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**PRINCIPAL INVESTIGATOR:** Ramble Ankumah
**CO-PRINCIPAL INVESTIGATORS:** Marceline Egnin and Guohao He

The relationship between physical and chemical properties of soils and soil biology is critical to understanding the interactions between these components of soil and how they respond to agricultural and environmental perturbations. Furthermore, how these perturbations affect the soil's capacity to perform ecosystem functions remain a primary goal of this focus area in soils research. Hitherto, prior studies have focused on individual aspects and have not brought together the tools to look at them in an integrative/multidisciplinary fashion. The available methods, together with current advances in soil biology, especially the development of 16S rRNA molecular tools, allows for the probing of this subject in a different way. The use of existing long-term plots with detailed history of land use allows us to compare these physico-chemical parameters of the soil with both soil enzyme activities and microbial communities and to better understand their relationship to soil health. This project uses these emerging tools in an interdisciplinary way to answer some

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