TEXTILE ENGINEERING RESEARCH PROJECTS 2006-07

Light Weight CBRN Protective Fire Fighter Turnout

R.L. Barker, D. Thompson
Department of Homeland Security
$1,232,793
12/10/2003 - 12/9/2007

This project is developing a prototype of a firefighter turnout suit that incorporates chemical and biological protection while retaining thermal resistance. The project integrates elements of advanced technologies including advanced barrier materials from DuPont. It involves the development of new thermal liner system and incorporation of new concepts in functional garment design for fire fighting applications. The project will end December 9, 2007 to allow for continued prototype refinements and demonstration of the new suit and to develop a glove and additional SCBA interface. We have conducted evaluations of the prototype at FDNY, Fairfax County, and Philadelphia Fire Departments.

Development of a Test Method for Measuring Stored Energy in Firefighter Turnouts

R.L. Barker,
NIOSH
$179,006
6/20/2005 – 9/20/2007

This project is developing performance criteria, designing a testing apparatus, and validating a laboratory testing method for measuring stored thermal energy in firefighter protective garment materials when exposed to convective and radiant heat energy. A test apparatus has now been developed and we are working in task groups of ASTM F23 to standardize the method we have developed.

Duralite Peer Review Response

R.L. Barker
CDC
$24,900
3/24/2006 – 8/18/2006

The external peer reviewer comments on the December 19, 2003 Report on Testing and Evaluation of Duralite® Turnout Gear are being addressed for preparation of a Letter Report. Additionally, a review, edit, and revision of the Final Report has been done and submitted to the sponsor.

Feasibility Investigation For Fabric-Based Ionizing Radiation Protection Garments

R.L. Barker, D. Thompson, R.E. Gorga
Defense Advanced Research Projects Agency (DARPA)
$52,034
9/1/2006 - 8/31/2007

Good progress has been made on forming films with potential capabilities to attenuate ionizing radiation. Spinning studies are currently being conducted to determine the feasibility of wet spinning fibers containing key additives. The target is to have sufficient proof of concept to present to DARPA , by early summer, to merit funding a larger research effort.

Analysis of Current Special Operations Forces Flame and Thermal Threats and Development of

Improved Test Methods
R.L. Barker
Battelle Memorial Institute
$268,286
7/27/2006 - 3/30/2007

This project has been successfully completed and all reports have been delivered to Battelle.

Man-In-Simulant-Test (MIST) Facility

R.L. Barker, K.R. Beck
Naval Air Systems Command
$298,265
8/31/2006 – 8/31/2008

The first phases of the facilities installation are underway, with contributions being made by many to this effort. With selection of a vendor for the MIST chamber, and contacts with University facilities, an intensive period of the installation and modification should soon begin, with a schedule to completing most of the installation by end of this summer. We have ordered a special instrumented manikin for use in the chamber. Identification or development of a suitable sensor for detecting MS, remains a critical technical goal.

PFOA Free Repellent Finishes

K.R. Beck, C.B. Smith
Institute of Textile Technology
$23,530
7/1/2006 – 7/1/2007

The graduate research assistant investigated a large number of short-chain fluorocarbon repellent finishes and compared their effectiveness with traditional fluorocarbon, hydrocarbon and silicone finishes. The project is complete.

Teegafix Reactive Dyes

H.S. Freeman and C.B. Smith
Procter & Gamble
$450,000
09/01/03 - 04/30/08

Our studies towards enhancing the commercial viability of Teegafix reactive dye technology continued. Achievements for the year included:

- The synthesis of new MCT/VS Teegafix dyes – Mengnan Zhao
- The application of the resultant dyes to cotton, giving yellow, red, and blue shades
- Evaluation of the performance of prototype yellow, red, and blue dyes in a plant-scale jet machine. This work included a cost analysis. – Matthew Farrell
- Developed HPLC methods for characterizing Teegafix dye intermediates – Kangqin Chen

- MS theses were written and defended by Mengnan Zhao, Kangqin Chen, and Matthew Farrell

Improved Yield Porphyrin Synthesis

H.S. Freeman, D. Hinks
Kimberly Clark
$300,000
2/16/04 - 2/15/07

This project pertains to the development of approaches to enhancing and commercializing synthetic porphyrin and subphthalocyanine technology developed at Kimberly-Clark and donated to NC State three years ago.

- David Hinks led studies pertaining to the use of porphyrin compounds as agents in photodynamic therapy. Several new compounds were made by Tim.

- Harold Freeman led studies pertaining to the use of porphyrin compounds as colorants for ink-jet printing,

- This work has led to funding from the US Air Force for the use of porphyrin compounds for self-decontaminating surfaces..

Modeling Industrial Dyes

H.S. Freeman, D. Hinks
Everlight Chemical Industrial Corporation
$49,742
08/01/06 - 01/31/07

This two-part proposal pertains to the design of dyes for polarizing films, with the ideal dyes having high transmittance (>40%) and high degree of polarization (99.9), and to the explanation of dye solubility. An essential step in the design of new target dyes is deemed to be the development of computer-aided approaches to predicting the light polarization characteristics of azoxy group-containing synthetic dyes and to enhancing the solubility of certain reactive dyes.

- We developed models for predicting degree of polarization for direct dyes in PVA and reactive dye solubility in NaCl/NaOH solutions.

- A final project report was submitted

Ionic Crosslinking – A Novel Method of Fabric Stabilization

Peter Hauser, Brent Smith
National Textile Center
$298,000
May 2004 - May 2007

The principle of fabric stabilization through ionic crosslinking was demonstrated. Wet wrinkle recovery angles and fabric strength were improved. However, dry wrinkle recovery angles and fabric hand were adversely affected. The final stages of this project will focus on other useful properties that can be realized from ionized cellulose.

Nanolayer Self-Assemblies: Novel, Adaptable Fiber Surfaces

Juan Hinestoza, Peter Hauser
National Textile Center
$12,000
May 1, 2006 - April 30, 2009

The student has generated anionic and cationic cellulose fabric and has begun training on the testing equipment that will be used to determine charge densities on the fabrics.

Atmospheric Plasma Development and Physical Testing and Performance Evaluation of Textiles for APJeT, Inc.

Peter Hauser
APJeT, Inc.
$111,190
October 15, 2006 - October 14, 2008

This project is in the equipment acquisition stage. A room has been prepared for the laboratory plasma unit and is being outfitted now for the project.

Processability of Knitted and Woven Fabrics from Yarns Containing Noveon Spandex

Abdel Fattah Seyam, Gary Smith, Peter Hauser
Noveon
$105,550
October 1, 2006 - September 30, 2007

This project is well underway with yarns and fabrics prepared, heat-set and scoured. The fabrics will be dyed and physical properties determined in the next few months.

Evaluation of Repellent Finishes Applied by Atmospheric Plasma

Peter Hauser
Institute of Textile Technology
$32,664
July 1, 2006 - July 1, 2007

This project determined that fluorocarbon repellents applied with the Dow Corning plasma system gave comparable results to traditional pad-dry-cure finishes for synthetic fibers, but non-durable repellency on cotton fabrics.

Durable and Environmentally Friendly Flame Retardants

Brent Smith, Peter Hauser
Institute of Textile Technology
$17,648
July 1, 2006 - July 1, 2007

This project found that phosphorous based flame retardants could be used as successful commercial replacements for bromine based flame retardants on selected polyester and nylon fabrics.

Durable and Nontoxic Topical Flame Retardants for Cotton and Cotton Blends

Brent Smith, Peter Hauser
Institute of Textile Technology
$17,646
July 1, 2006 - July 1, 2007

This project found that traditional phosphorous based flame retardants provided acceptable, durable flame retardancy to selected cotton fabrics.

Smart Nanocomposites Design: From Molecular Structure to Bulk Properties

R.E. Gorga, L.I. Clarke, W.E. Krause
NCSU FRPD Inderdisciplinary Program
$20,000
8/1/2006 – 8/1/2007

Conductive core/sheath nanofibers: Develop a technique to create conductive nanofibers in a core/sheath configuration. Characterize the mechanical, electrical, and morphological properties as a function of material characteristics and processing parameters. Developed an apparatus to fabricate bicomponent nanofibers. Future work will focus on quantifying morphology and mechanical/electrical properties.

Mechanistic Understanding and Optimization of Thermal Bonding for Bicomponent Polymer Fibers

R.E. Gorga
Nonwovens Cooperative Research Center (NCRC)
$20,000
8/2006 – 7/2007

Develop and characterize bicomponent fibers to optimize melt-bonding without compromising molecular orientation.

Fundamentals of Fiber Formation in the Spun-Bond Process

R.E. Gorga, D. Schiffler, H. Tafreshi
Nonwovens Cooperative Research Center (NCRC)
$177,500
8/2006 – 7/2009

Characterize fiber orientation and develop a predictive model to optimize fiber orientation for a given application.

Electrospinning Behavior with an Auxiliary Faraday Field Surrounding the Electrostatic Field of the Extrusion Process

B.S. Gupta
EMPA, St. Galen, Switzerland
$43,100
8/15/2005 – 10/31/2006

In electrospinning, challenge lies in producing fibers that are uniform in size and void of drippings. Using a charged Faraday metallic cage surrounding the primary pump-collector device a superior extrusion product, void of drippings, and producible with more tolerant use of extrusion conditions is obtained. Experiments involved secondary/primary voltages in several ratios and this was coupled with PCL polymer concentration, pump speed, and magnitude of the primary voltage. The new configuration found is now used in conducting the experiments of our primary NTC project.

Functional Textile Surfaces for Preventing Bedsores (Decubitus Ulcers)

B.S. Gupta
TUBITAK Textile Research Center, Turkey
$2,500
8/1/2005 – 1/31/2007

Bedsores develop when a patient is immobilized on bed due to health reasons. For most patients, potential of bedsores can be alleviated by engineering fabric with differential friction, i.e. higher friction between skin and bedwear and lower friction between bedwear and bed-sheet. Fabrics differing in construction were examined for the effect of structure on friction. Strategy was sought to greatly lower friction by modifying surface with Teflon strategically placed. Currently, clinical data is being collected at the Ege University medical School. Parallel work is being conducted at USDA Labs in New Orleans. Two papers were presented during the year.

Fiber Size and Web Mass Distribution in Electrospun Webs of Synthetic Polymers

B. S. Gupta
Howard Hughes Medical Institute, Student Research Intern Program, NCSU, and NTC Research Experience for Undergraduate (REU)
$17,000
05/31/2005 – 8/4/2006

In electrospinning, a polymer droplet emerging from capillary gets attenuated and flies in a relatively unknown and unpredictable manner towards the collection plate. For developing uniform tissues, the scaffold must be uniform in mass distribution but little is know about it. Three polymers were electrospun under a range of conditions and web samples, stamped out from several pre-specified regions, were characterized for mass and fiber size. The results yielded a profile providing invaluable information about the character of the collected web and its relation with electrospinning parameters. Three poster presentations have been made based on the undergraduate students' research.

Electro-Spun Core-Sheath Fibers for Soft Tissue Engineering.

B. S. Gupta, M. King, S. Hudson, E. Laboa
National Textile Center
$400,846 ($111,789 Gupta)
5/1/2005 – 4/30/2007

Sheath-core bi-component nanofiber structures are developed for use in tissue engineering. Using electrospinning process, collagen and PCL nanofibers are extruded with a co-axial syringe. The natural polymer in sheath aids in cell proliferation while the synthetic polymer in core imparts strength and elasticity. Both biodegrade, but differentially. Studied are the effects of process and material factors on the web's structure and properties and its potential for promoting cell adhesion and proliferation. The project received Director's award at the 2007 NTC Conference. Several papers have been presented in national and international conferences and published in proceedings.

GATS Performance of a Number of Commercial and Model Tampons

B. S. Gupta
Playtex Products Inc.
$17,825
7/10/2006 – 11/1/2006

One of the major uses of absorbent rayon is in catamenial tampon for absorbing menstrual fluid. These medical products must be small in mass and physical size, absorb fluid rapidly, and retain it under pressure till the product is saturated and needs to be discarded. No convenient test device was available that effectively characterized a products performance. A special device was designed and constructed that fitted on the existing Gravimetric Absorbency Testing System (GATS) and held a tampon at physiological pressure while the product absorbed a reconstituted body fluid. A disclosure is scheduled to be filed on the invention.

Capillary Absorption of Reconstituted Body Fluids by Catamenial Tampons

B. S. Gupta
Playtex Products Inc.
$34,940
10/23/2006 – 6/15/2007

Catamenial tampons must absorb the body fluid released instantly and continue to do so throughout a given tampon's absorption cycle. However, usually the rate of absorption is exponential and decreases with time as fluid is absorbed. In this project, the scope was to characterize absorption rate using the newly designed equipment at many different stages of absorption and develop an understanding of the factors (material and construction) that could be used to enhance and optimize the performance. A design that allows a tampon to expand laterally provided the advantage.

Self-Decontaminating, Photocatalytic Textile Materials

David Hinks and Harold Freeman
US Air Force
$180,000

May 1, 2007 - April 30, 2008

We are thrilled to have received this grant. It will involve extensive work at Tyndall USAF base. Dr. Hubert Gill is currently being hired as a Visiting Assistant Research Professor, and we believe Sasha Polianski is seriously thinking of undertaking the project with a view to obtaining a PhD in FPS.

Cationic Bleach Activators

David Hinks and Peter Hauser
Proctor and Gamble
$300,000
5/1/2003 - NA

As can be seen from the publication record this year, we have been productive in reporting the extensive work on this project. We are about to run trials at Cotton Inc, and I intend to reach out to the paper industry for funding on bleaching of paper. We also believe the technology is best suited for cold pad batch, and will look for funding for technology development in Europe (where pad batch is more prevalent than the US).

Effect of Fluorescent Brightening Agents on Whiteness Perception and Measurement

David Hinks and Renzo Shamey
$0
8/1/2004 - 5/30/07

Last year, I reported that we anticipated funding from Unilever. However, we have hit a frustrating road block with IP with this company. I hope to revisit this project during a trip to the UK in October, 07. Changhai Xu is the student working on the project. In fact, we are combining some work on FBAs with the bleach activator. Changhai had the idea of preparing a coplanar direct dye-shaped FBA containing two bleach activator groups. We think this is a stellar idea, and synthesis is underway.

Chitosan Mucoadhesives

S. Hudson
Luna Innovations (Prime: NIH)
$25,000
7/01/05 - 12/30/06

Mai Yamazaki conducted this work for her thesis. Blend films of chitosan and silk were prepared and treated with di-aldehydes. Didecanal was synthesized. A colorometric method was developed for determining the amount of free aldehyde groups available. All deliverables to Luna were met.

Evaluation of Carbon Nano Tube Yarn Composites

S. Hudson
3TEX (Prime: US Air Force)
$75,000
09/20/05 - 07/30/07

Phil Bradford is evaluating carbon nanotube yarns and braids supplied by 3TEX. Tensile and microscopic observations are being collected. Initial epoxy composite samples of the braids have been obtained. A 5N load cell for the Dept. Instron of Dr. Gorga was purchased. His paper won the competition as the best technical paper submitted, at the national SAMPE Conference in Oct. 06.

Innovative design of garments for healthcare patients.

T. Plumlee, N. Powell, S. Michaelson, S. Hudson, C. Istook
Robert Wood Johnson Foundation
$236,110
11/15/06 - 11/15/07

The faculty on this project will begin literature surveys in their respective fields on this topic. Hospital patient gowns are the subject. The work will lead to a specific proposal on the redesign of the garment. This project is seed money to develop a larger multiyear project to implement the proposed design.

Quantifying Information Sharing in a Supply Chain

J.A. Joines, K.A. Thoney, R.E. King, T. Hodgson
National Textile Center
$533,720 ($133,429)
5/1/2004 - 4/30/2007

Seonghoo Yoon will be defending his Preliminary on May 7th. He has been able to show the quantitative value of sharing information. More importantly he has been able to characterize the policies that have originated from the Markov Decision Process methodology that we should be able to incorporate into a simulation tool that can look at more complicated systems.

Adapting Lean Principles for the Textile Industry

J.A. Joines, K.A. Thoney, G.L. Hodge
Institute of Textile Technology,
$40,963
7/12006 - 6/30/2007

The purpose of this research is to determine which lean principles are appropriate for implementation in the textile industry. Lean manufacturing involves a variety of principles and techniques, all of which have the same ultimate goal: to eliminate waste and non-value-added activities at every production or service process in order to bring the most satisfaction to the customer. The two students interviewed and worked with 11 textile companies on lean principles. We were able to determine the things that companies did that were successful and the barriers these companies went through in implementing the principles of Lean. Based on the interviews we were able to identify several road maps or best practices in applying 5S and Value Stream Mapping for textile companies. We also performed several case studies at

a few of the companies. We developed a value stream map and discovered several areas of improvement.

Plant Floor Scheduling Systems in a Lean Environment

J.A. Joines, K.A. Thoney, G.L. Hodge
Institute of Textile Technology,
38,907
7/12006 - 6/30/2007

The objective of this study was to determine how companies in the US textile industry are using lean manufacturing practices in their planning and scheduling systems. The study uses primary and secondary data sources to explore the utilization of lean techniques in manual or automated planning and scheduling systems. Very few were using scheduling lean tools. These two projects worked in conjunction with one another to develop solutions for a scheduling system used in the Warping and Slashing of a medium sized textile company.

The Production of Profitability: Optimization and Control of Increasingly Complex Textile Plants

Jeff Joines and Chris Moses
Institute of Textile Technology,
$16,500
8/1/2006 - 8/30/2007

The first part of the research dealt with looking at all of the different performance metrics used in plants (i.e., machine efficiency) and supply chain metrics to determine which ones maybe more effective in helping companies identify and manage complexity. This summer we will be working on finishing up the project by developing some Monte Carlo simulation tools to help companies assess their complexity issues.

Create and Implement a modified Business Plant To Expand ITT's Membership

Jeff Joines and Bob Barnhardt
Institute of Textile Technology,
$16,500
5/15/006 - 8/15/2006

Even though this was not a sponsored project through the university (i.e., ITT paid for it directly), we did some nice work. Originally we were developing a database system that would allow ITT to expand its current membership. After we completed the decision support system, it became clear that the system could be used on many fronts (i.e., sourcing capabilities, developing focus areas for recruitment and research). I developed the database model and the prototype decision support system with searching capabilities that allows ITT to data mine the database looking for commonalities. Reece gathered the enormous amounts of data to populate the database while Bob gave his expertise on determining what information we needed as well as the kind of questions the database should be able to answer. This work has led to me being part of a department of commerce project with Nancy Cassill who is developing a similar effort.

Ligands from Combinatorial Libraries for Prion and Viruses Detection and Removal

Richard Kotek
Prometic
$268,294
April 1, 2006 - March 30, 2007

This is privately funded project that is now directed toward development of proprietary filters for prion removal from human blood. The sponsor asked us to keep the experimental data and research reports confidential. We have completed this project now.

High Modulus Aliphatic Nylon Fibers via Lewis-Acid Complexation

Richard Kotek, Alan Tonelli
National Textile Center
$341,627
May 1, 2005 - April 30, 2007

Significant progress has been made for the anionic polymerization of caprolactam to increase an average molecular weight to $700,00 g/mol. This allows to improve spinnability and physical properties of nylon fiber.. The polymer will be used in a newly researched gel spinning process. The latter will be also used for poly(vinyl alcohol). Initial studies gave PVA fiber having tenacity of 12 g/mole.

New Class of Cellulose Materials

Richard Kotek
National Textile Center
$72,073
May 1, 2006 - April 30, 2007

Hyun demonstrated for the first time that cellulose with DP of 430 can be easily dissolved in salt/ethylenediamine solvent system. The resulting spinning dope was utilized in the dry jet wet spinning process to produce regenerated cellulose fibers with tenacity of 4 g/d. A newly developed, environmentally friendly process is has a tremendous advantage over Lyocell (explosive solvent!) and viscose processes (lots of pollutants). Dr. Kotek made a presentation at American Chemical Society Meeting, Chicago, IL, USA, March 25 – 29, 2007 to demonstrate this good result.

Melt Spun Industrial Fibers

Richard Kotek, John Cuculo
Performance Fibers
$206,350
May 1, 2006 - April 30, 2007

This is privately funded 3 year project is directed toward the development of proprietary high tenacity fibers. The sponsor asked us to keep the experimental data and research reports confidential. A new process has been discovered. A patent application is being prepared.

Hydrodynamic Lubrication in Fiber Processing

W.E. Krause, J. Krimm, O.J. Rojas
National Textile Center
$163,780
5/1/2006 - 4/30/2007

We will develop and apply advanced rheological and lubrication testing technology to address a number of fundamental questions of industrial significance in regards to the hydrodynamic lubrication of fibers, including: 1) Why do fibers based on different polymers have different frictional properties in the hydrodynamic region (not predicted by lubrication theory)? 2) What are the variables controlling the hydrodynamic frictional behavior of complex lubricant formulations? And 3) What are the fluid film thickness, the

real shear rates and the extent of heating within the hydrodynamic fluid film during high speed friction?

Boundary Lubrication and Molecular Assembly in Fiber Processing

O.J. Rojas, J.P. Hinestroza, and W.E. Krause
National Textile Center
$110,299
5/1/2005 - 4/30/2007

Friction; wear, and lubrication are critical considerations at various stages of fiber processing. Today a comprehensive understanding of the frictional behavior of thin films relevant to fiber processing does not exist. Therefore, we will investigate the fundamental physics of fiber lubrication. The objectives of this study include: (1) characterization of the micro-structural and surface properties of contact regions between fiber and pin; (2) elucidation of the molecular assemblies in boundary films and their relationship with observed macroscopic behaviors; and (3) development of structure-property relationships to assist in the formulation of fiber lubricant formulations with improved performance.

Nanomedicine: The Interface of Biology, Medicine, and Nanotechnology

W.E. Krause and R.E. Gorga
Interdisciplinary Nanotechnology Research Program (N.C. State)
$50,000
8/2005 – 8/2006

Develop a tissue engineering scaffold through the electrospinning process with the addition of carbon nanotubes and/or nanoparticles into the scaffold to produce a novel material for tissue regeneration and for the exclusive goal of inducing human mesenchymal stem cells into osteogenesis. Showed ability to electrospin fibers with MWNTs embedded in them. Showed linear increase in conductivity as a function of nanotube loading. Showed control of morphology as a function of processing conditions (manuscript in preparation of JPS: B). Future work includes cell studies for viability and growth/differentiation.

Textiles with Permanent Physical Insecticidal Activity

Marian McCord, Richard M. Roe
National Science Foundation
$49,999
9/06 – 8/07

A new generation of non-chemical insecticidal textiles has broad applications in prevention of disease and reduction of environmental risks associated with insecticidal chemicals. To create a "next generation" of insecticidal textiles that relies solely on non-chemical, non-toxic, and risk-free properties that physically prevent insect biting and disable or kill insects via physical interactions with the textile surface or interior, we are evaluating factors in fabric construction that control ability to bite through the textile; evaluating interactions of mosquitoes with fabric surfaces and structures and evaluating potential for injury; and designing fabric structures that prevent bites and disable insects.

Stain Repellent-Antimicrobial Textiles via Atmospheric Plasma Finishes

Lei Qian, Marian McCord, Mohamed Bourham
Institute of Textile Technology
$47,043
3/06 – 7/07

Production of stain-repellant antimicrobial textiles represents important multifunctional fabrics for everyday use. Production of antimicrobial textiles via atmospheric plasma activation techniques has shown great success and strong market potentials. Fabrics grafted with antimicrobial agents via atmospheric plasma-aided processes extend over a wide range of textiles and have been evaluated for efficiency and durability. The extension of plasma technique in graft copolymerization of bioactive monomers onto fabrics with additional stain repellency feature will be investigated in this proposed research. Ions from helium, oxygenated helium and fluorocarbon helium plasmas will interact with the fabric to create active sites on the fabric surface.

Biomedical Device Innovation

Marian McCord and Mitzi M. Montoya
NCSU Internationalization Seed Grant
$5,000
7/06 – 7/07

This project represents an opportunity to create a structure for collaboration in development of a new program that will provide training in the rapid growth area of biomedical device technology.

Molecular Simulations for the Design and Optimization of NanoBiosensors

Melissa A. Pasquinelli
State Appropriated Funds
$16,000
01/05/2007 – N/A

The goal of this project is to utilize molecular simulation methods for studying the components of an acetylcholinesterase-liposome nanobiosensor and how the underlying physiochemical interactions of the components impact its function. This information will then be adapted in order to devise methods that can study the characteristics of a complete nanobiosensor (i.e., at the systems level) from its molecular constituents. These methods can be used to guide the design and optimization of more efficient and effective nanobiosensors, and also to investigate the functionality of these nanobiosensors when they are integrated into materials such as textiles.

Image-based Fiber Length Measurement

J.P. Rust
Gifts
2004 - 2007

Michael Tompkins graduated in August 2006 after developing the second generation system which proved to be more capable. I was invited by a major player in the farm supplies and equipment business to present a proposal (4/25/07) to: build a prototype to measure Short Fiber Content in cotton samples, test and evaluate the prototype, and structure a long-term cooperative plan for implementation at gins across the country. The NC State Office of Technology Transfer has accepted management of the patent disclosure and patentability is currently being evaluated. We have until August 2007 to file the patent application.

The Effect of Preparation, and Dyeing on

Performance of Fiber Identification Tagging Components: Marks & Codes

Renzo Shamey
DOE Flowthrough, UT-Battelle LLC
$100,000
01/03/06 - 07/30/07

The project is progressing well. The stability of taggants to various conditions including light, wash and rub fastness tests in currently being examined. A postdoctoral associate was hired in July 06 and the work is near completion. A stop work order was received in December 06 from ORNL due to a dispute between ORNL and Small Business Administration (SBA) who are funding the project. We are awaiting the resolution of the issue to continue the final stages of the work. It is anticipated that subject to resolving IPR issues peer-reviewed papers will be published from the results of this work.

The Effect of Temperature, Moisture Content and Special Finishes on Color of Dyed Fabrics

Renzo Shamey
Gift from Dr. K. Muthusamy
$5,000
03/30/06 - 12/30/06

This short project finished in 06 and resulted in an undergraduate 490 project as well as summer work with another undergraduate. Work with a visiting research scholar is currently being prepared for peer reviewed publication.

The Development of Optical Reader Technology and Image Processing Solutions to Identify Fiber Tagging Components

Renzo Shamey
DOC
$476,000
08/01/06 - 07/31/07

This project officially started in August 06 but due to IPR issues with ORNL did not effectively start until Jan 07. A request for a 10 month extension has been submitted to Department of Commerce. Initial work has resulted in configuration of model images for capture, identification of target and decoding of pixels. Two presentations have been made to various audiences. We have had one presentation based on the results of this work and expect to generate additional publications.

Joint US Egypt – Environmentally Friendly Finishes

Brent Smith
National Science Foundation
$28,500
May 31, 2006 - August 2007

Hashem will visit this summer to perform the work of this project. I expect him to be here in May/June.

Improving Textiles with Cyclodextrins

A. E. Tonelli and C. M. Balik (NC State), M. Srinivasaro (Ga-Tech)
National Textile Center
$900,000
5/1/06 - 4/31/09

Coalescing polymers from cyclodextrin (CD)-inclusion compound (IC) crystals generally (i.) increases crystallinity and melting and decomposition temperatures; (ii.) molecularly mixes and produces intimate blends of two or more polymers that are normally immiscible; (iii.) provides control of the phase segregation of incompatible copolymer blocks; and (iv.) all with substantial thermal and temporal stabilities. We have demonstrated the aqueous dyeing of TiO-filled polypropylene with a water-soluble CD-rotaxanted-diazo-dye and polymerized nylon-6,6 containing covalently bonded CDs, which have a high affinity for dyeing and presumably for other textile additives. We have also produced spermicidal and insect repellent polymers/textiles by embedding them with CD-ICs.

Use of Cyclodextrins for Sustained Delivery of Follicle Stimulating Hormone in Superovulation Protocols for Goats and Cattle

A. E. Tonelli, C. E. Farin, P. W. Farin (Animal Biol., NC-State Vet School)
NC-State-CVM Center of Comparative Medicine & Translational Research
$15,000
5/1/06 - 4/30/07

Superovulation of ruminant livestock is a common management practice used to increase the productivity of valuable females. Superovulation is achieved by administering follicle stimulating hormone FSH twice daily over a 3 or 4 day period. Establishing an effective superovulatory treatment that minimizes the number of injections required would be of substantial benefit to the livestock industry.

Use of a Cloprostenol-Cyclodextrin-Inclusion Complex (CCIC) delayed-release formulation to shorten the estrous cycle in pigs.

A. E. Tonelli, John Gadsby (Molecular Biomedical Sciences, Vet School)
USDA
$10,000
6/1/06 - 5/31/07

We have demonstrated by NMR that γCD forms a soluble complex with Cloprostenol in solution, and it is currently being tested for superior delivery of Cloprostenol to pigs.

Lithium Alloy-Carbon Composite Nanofibers for Energy Storage by Electrospinning and Carbonization

Peter S. Fedkiw, Saad A. Khan, Xiangwu Zhang, and Robert M. Spotnitz
National Science Foundation
$380,000 ($77,480)
9/1/2006 – 8/31/2009

Under Zhang's guidance, Liwen Ji has synthesized nanoparticulate-incorporated polymer nanofibers. We will further fabricate them into nanofibers for energy storage.

Novel Composite Nanofiber-Based High-Performance Fuel Cells by Electrospinning

Xiangwu Zhang
FRPD Individual Program
$8,000
7/1/2006 – 6/30/2007

The objective of the project was to initiate research activities for the development of novel nanofiber-based electrolytes

and electrodes for high-performance fuel cells. Nanofiber-based fuel cell components developed in this project have the advantages of: i) low cost, ii) high operating temperature, iii) good catalyst utilization, and iv) large active membrane/electrode interface. Results obtained from this work have been used as preliminary work to support a recent Air Force proposal entitled "Advanced Nanofiber-Based Organic-Inorganic Hybrid Membranes for Fuel Cells".

High-Performance Silica Fiber-Polymer Electrolytes for Next-Generation Lithium Batteries

Peter S. Fedkiw, Xiangwu Zhang
Sumitomo Electric Industries, Lt
$120,000
1/3/2006 – 1/2/2007

The project focused on combining NCSU's expertise in functionalizing silica surface and battery systems with Sumitomo Electric Industries, Ltd. (SEI)'s leading fiber technologies to develop high-performance electrolytes for next-generation lithium batteries. In this work, SEI's silica fibers were surface-modified to obtain functional properties, especially high-ionic conductivity. Electrolytes based on these modified silica fibers have excellent overall performance and have the potential to be used in commercial lithium and lithium-ion batteries.

Mettler MT5 Balance for Energy-Related Education

Peter S. Fedkiw, Xiangwu Zhang
U.S. Department of Energy
$8,760
10/1/2005 – 9/30/2006

A Mettler MT5 Balance was obtained from Sandia National Laboratories. This balance can be used in studying the water uptake of electrolyte membranes for fuel cell research.

TEXTILE ENGINEERING FACULTY

Dr. Roger L. Barker, (919-515-6577), Burlington Industries Professor, Ph.D. Fiber and Polymer Science – Clemson U., Physical properties of fabrics and clothing systems. (Heat resistant fabrics, fabric comfort and hand, moisture transport mechanisms; protective clothing). [roger_barker@ncsu.edu]

Dr. Keith R. Beck, (919-515-6558), Professor and Department Head, Ph.D. Organic Chemistry – Purdue U., Synthetic and analytical (especially NIR, UV-VIS and HPLC) aspects of textile chemistry. Real-time data acquisition in dyeing processes by FIA and SIA. [keith_beck@ncsu.edu]

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Dr. Russell E. Gorga, (919-515-6553), Assistant Professor, Ph.D. Chemical Engineering – Iowa State University, Mechanical and electrical properties of nanocomposite fibers and films. Structure-property relationships of polymer systems. Surface and interfacial properties of polymers with an emphasis on biomedical applications. [russell_gorga@ncsu.edu]

Dr. Bhupender S. Gupta, (919-515-6559), Professor, Ph.D. Textile Physics – University of Manchester Institute of Science and Technology, Frictional behavior of fibers and textiles; absorption phenomena and absorbent structures; biomedical textiles (sutures, knot security, arterial grafts); characterization of porosity and pore size distribution; surface energetics. [bs_gupta@ncsu.edu]

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Dr. Warren J.Jasper, (919-515-6565), Associate Professor, Ph.D. Aeronautics and Astronautics – Stanford University, Use of computers to monitor, model and control textile processes. (Modeling and controlling batch dyeing, neural-networks, fuzzy logic control, image processing techniques to control/detect fabric defects). Color science. [warren_jasper@ncsu.edu]

Dr. Jeffrey A. Joines, (919-513-4188), Assistant Professor, Ph.D. Industrial Engineering – NC State University, Optimization and modeling of complex systems utilizing computer simulation, traditional search methods, genetic algorithms, neural networks, and fuzzy logic. [jeffjoines@ncsu.edu]

Dr. Wendy E. Krause, (919-515-6560), Assistant Professor, Ph.D. Chemistry (Material Sciences and Engineering) – Penn State University, Structure-property relationships of macromolecules, with emphasis on biomaterials, medical textiles, rheology, lubrication, and polyelectrolytes. [wendy_krause@ncsu.edu]

Dr. Marian G. McCord, (919-515-6571), Associate Professor, Ph.D. Textiles and Polymer Science, Clemson University, Plasma treatment and finishing, tissue engineering, biomaterials; barrier fabrics; fiber structure/properties; nanocomposite fibers. [marion_mccord@ncsu.edu]

Dr. Melissa A. Pasquinelli, (919-515-9426) Assistant Professor, Ph.D. Chemistry - Carnegie-Mellon University, Computational modeling as a tool for understanding, predicting, and modulating the physical and chemical properties of macromolecules. Structure-property relationships of nanotechnological and biologically-inspired materials. [melissa_pasquinelli@ncsu.edu]

Dr. Jon P. Rust, (919-515-6564), Professor and Associate Department Head, Ph.D. Fiber and Polymer Science – NC State University, Process reengineering, especially with regard to fiber-to-yarn conversion and fiber preparation, novel processes and systems, machine and process design. [jon_rust@ncsu.edu]

Dr. Xiangwu Zhang, (919-515-6547), Assistant Professor, Ph.D. Materials Science and Engineering, Zhejiang University, China, Nanostructured and multifunctional polymer, composite, fiber, and textile materials. Structure-property relationships with an emphasis on energy-related applications.

CONTACT INFORMATION

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http://www.tx.ncsu.edu/departments/tecs/index.html

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