

## ***NTC Annual Report Introduction***

The National Textile Center (NTC) is a research consortium of eight universities: [Auburn University \(Consumer Affairs, Engineering\)](#), [University of California at Davis](#), [Clemson University](#), [Cornell University](#), [Georgia Institute of Technology](#), [University of Massachusetts at Dartmouth](#), [North Carolina State University](#) and [Philadelphia University](#).

To view the full Annual Report of the work described in the highlight below, click on the project number. For further research details, see the project's website reported in this Annual Report or in the 2004 Research Briefs, on the web at <http://www.ntcresearch.org/pdf-rpts/Bref0604/Briefs04-TOC.pdf> or on the latest CD/ROM. You can keyword search and view all NTC Reports ever published at <http://www.ntcresearch.org/PDFindex.html> and view all reports on the CD.

To contact any principal investigator, see their bio following each Research Brief for their email address, phone, web-site address and NTC project numbers. Bios for all principal investigators who ever participated in an NTC project are continuously updated on the web at [http://ntcresearch.org/PDF\\_BIO\\_index.htm](http://ntcresearch.org/PDF_BIO_index.htm) and/or on the latest CD/ROM.

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## ***NTC Annual Report by Competency Groups***

### ***Materials***

*Research in the design, development and measurement of natural and synthetic polymeric materials and fibers, including polymer mixtures and additives.*

#### **Fluoropolymer Optical Fibers, Fiber Amplifiers, Lasers for “Smart” Textiles**

We are developing fluoropolymer optical fibers, fiber amplifiers and lasers that enable the reliable reception, routing and secured broadcasting of information for use in “smart” textiles. (Ballato) [M01-CL01]

#### **Surface Modification of Fibers with Hybrid Polymer Nanolayers**

We are developing ways to create multi-functional responsive/adaptive fibers and textiles which can modify their properties in response to external stimuli. (Luzinov with Iowa St) [M01-CL03]

#### **Dynamic Chameleon Fiber Systems**

We are designing fibers that can quickly change their color, hue, depth of shade or optical transparency by application of an electrical or magnetic field. (Gregory with Furman, Georgia Tech) [M01-CL07]

#### **Biodegradable Hydrogel-Textile Hybrid for Tissue Engineering**

Using biodegradable hydrogel technologies and non-woven fabrics, we are developing textile-based scaffold biomaterials for engineering new tissues and organs for human body repair. (Chu w Binghamton) [M01-CR01]

#### **Predicting Chemical Penetration Through Nonwoven Protective Clothing**

We developed models to predict pesticide penetration and air permeability through woven personal protective clothing. (Obendorf) [M01-CR02]

#### **High Modulus, High Tenacity Melt Spun Fibers**

We are developing techniques to describe the morphology of high tenacity/high modulus fibers to levels not previously possible. (Michielsen) [M01-GT01]

#### **Fiber Structure Evolution During Spinning**

We are investigating strain induced morphology development in fibers to understand the evolution of structure during the fiber formation process. (Jacob with SUNY, Ohio St, UMassAmherst) [M01-GT04]

## **Electrostatic Spinning and Properties of Ultrafine Fibers**

We are developing the fundamental understanding and technology of electrospinning and to controllably produce  $<0.1\mu$  diameter electrospun fibers. (Rutledge, M.I.T., with UMassD) [M01-MD22]

## **High Strength Polyamides by Suppressing Hydrogen Bonding**

By suppressing interchain amide group hydrogen bonding during spinning and drawing, we have produced the highest published tenacity and modulus for nylon 66 fibers. (Kotek with TRI) [M01-NS03]

## **Transport in Fibrous Substrates: Liquid and Solid Interactions**

From microscopic liquid and solid interactions, we are developing stochastic models to predict liquid transport behavior in fibrous substrates. (Pan with Cornell) [M02-CD03]

## **Functional Fibers for Immobilization of Biomolecules**

We are developing processes to chemically activate the surface of fibrous materials for the recovery of biomolecules, such as specialty enzymes, by encapsulation/immobilization. (Hsieh with Natick) [M02-CD05]

## **Biomimetic Manufacturing of Fibers: Materials Development**

Using spider silk and collagen as a model, we are investigating the role that protein primary structural components play in protein expression and in fiber production and properties. (Ellison) [M02-CL04]

## **Photonic Crystal-Based Polymer Optical Fibers**

We are generating ways to produce and microfabricate photonic crystal fibers that exhibit extremely low-loss light transmission for communications and sensing uses. (Brown) [M02-CL06]

## **Nano Engineered Fire Resistant Composite Fibers**

We are developing a fundamental understanding of the thermal insulation of heat and fire resistant polymeric composite fibers when embedded with nanoparticle fillers. (Patra with Auburn) [M02-MD08]

## **Polymers Processed with Cyclodextrin Inclusion Compounds**

We are developing a fundamental understanding of how cyclodextrin inclusion compounds deliver properties (e.g. flame retardancy, antibacterial, color) to polymers during processing. (Tonelli with Ga Tech) [M02-NS01]

## **E-textiles from Embedded Nanotube Actuators/Sensors**

By embedding carbon nanotubes in polymer during spinning, we are developing fabrics for actuation and sensing. (Jalili) [M03-CL07s]

## **Biologically Active Bioabsorbable Fibers for Biomedical Uses**

We are developing poly(ester-amide)-based, biologically active bioabsorbable fibers with improved biodegradation and biological properties for biomedical applications. (Chu with UTenn) [M03-CR04]

## **Nano Crafted Layered Optical Filaments for Diffractive Colors**

By developing a molecular level understanding of optical functionality of mirror fibers, we can design fibers that can reflect or transmit light for optimal cooling or warming. (Calvert with Clemson) [M03-MD14]

## **Liquid Wetting and Flow in Nano-Fibrous Systems**

We are developing computer models to predict and characterize wettability, permeability, flow, transport phenomena and absorbency in nanoporous fibers and nano-fibrous substrates. (Hsieh with TRI) [M04-CD01]

## **Distributed Sensors and Actuators via Electronic-Textiles**

Using electrospinning, we are developing non-woven "e-textiles" containing charged carbon nanotubes to provide enhanced sensing capabilities for more reliable and accurate feedback. (Jalili) [M04-CL05]

## **Poly(lactic acid) Derived Fibers with Enhanced Performance**

We are researching ways to significantly enhance the thermal and mechanical performance of biodegradable fibers from renewable resources (e.g. lactide from corn sugar). (Smith with TRI) [M04-CL07]

## [Surface Modification of Capillary Surface Material Fibers](#)

We are tailoring the surfaces of capillary surface material fibers using linear, hyperbranched and comb-polymer migratory additives for biomedical applications. (Hirt with Florida) [M04-CL11]

## [Cellular Encapsulation into Porous Alginate Fibers](#)

We are developing fibrous biomaterials with genetically modified cells that release biological agents that emulate normal wound healing of body tissue. (Brown with Rhode Island) [M04-CL13]

## [Nano Scale Polymerization and Fiber Spinning](#)

We are researching ways to polymerize polyamide and polyester nanofibers through mesoporous channels to yield exceptionally high mechanical properties without drawing. (Jacob with Ohio St) [M04-GT11]

## **Terahertz Properties of Textiles: Metamaterials, Sensors and Security**

See [proposal](#) or upcoming initial report in June 2005 Research Briefs (Citrin) [M04-GT19s]

## [Textile Fibers Engineered from Molecular Auxetic Polymers](#)

We are developing polymeric fibers that exhibit a strong bulk auxetic response under tensile stress as a result of fundamental lateral expansions on a molecular level. (Griffin) [M04-GT21]

## [Quantum Tunneling Nanocomposites as Sensors and Actuators in Fabric](#)

We are developing a fundamental understanding of how quantum tunneling nanocomposites act as sensors and actuators that respond to force, temperature and volatile organic compounds. (Patra) [M04-MD07]

### ***Fabrication***

*Research in the fabrication, processing and manufacture of fibrous structures and fabricated products.*

## [Magnetic Ring-Spinning for Increased Speeds](#)

By replacing the traveler in ring spinning with a disc that rotates in a magnetic field, we hope to maintain the high quality of ring spun yarn, but at much higher speeds. (Abdel-Hady) [F01-AE02]

## [Nonlinear Dynamics of High Speed Transport in Non-Uniform Yarns](#)

A phenomenological model of surface forces must span the probable physics of the sliding yarn; qualifying such a model requires more precise *in-situ* "measurements" of yarn path. (Goswami with U.Sydney)[F01-CL04]

## ["Green" Composites from Cellulose Fabrics & Soy Protein Resin](#)

Using modified soy protein as the resin, we developed flax yarn-reinforced unidirectional, biodegradable composites and flax fabric-reinforced panels having sufficient mechanical properties. (Netravali) [F01-CR01]

## [One Step Carding-Spinning](#)

We have successfully integrated the fiber opener, card, web divider, yarn spinning head and winder into one continuous system. (Wang with Clemson) [F01-GT06]

## [Micromachines in Fabric Formation](#)

We are developing mechanisms that combine micro-electro-mechanical systems (MEMS) and robotic devices to automatically repair broken warp ends, thus leading to fully automated weaving. (Seyam) [F01-NS14]

## [Modeling Thermal Protection of Apparel](#)

We are developing a model to predict heat and moisture transport in firefighter protective clothing during flash fire exposures. (Barker) [F01-NS50]

## [Compressive Behavior of Fiber Assemblies](#)

We are characterizing compressive behavior of fiber assemblies with a combination of modeling and experimental techniques. (Jacob) [F02-GT04]

### **Layered Fiber-based Microtubes**

We are exploring the technological potential of submicron diameter tubing of electroactive polymeric materials for applications in sensing and actuation. (Ghosh) [F02-NS05]

### **Virtual 3D Draping of Apparel**

We are developing methods for an accurate, virtual 3-D draping of apparel on a digitized 3-D model of the human body considering variations in fabric mechanical properties. (May-Plumlee) [F02-NS08]

### **Textile Prostheses for Vascular Applications**

We are developing prototypes of ‘textile stents’ for endovascular implantation in humans, to replace commercially available metal stents. (Adanur with UMassD, Emory U.) [F03-AE02]

### **Electro-Static Web Formation**

We are using electrostatic field forces to form webs with positively controlled fiber orientation and minimal hook formation for improved strength, pore size and bending behavior. (Kim with NC State) [F03-MD01]

### **Bio-active Bandages**

We are embedding functionally-active, genetically-engineered, mammalian cells into textile fibers for such uses as bioactive bandages. (Bhowmick with Harvard) [F03-MD15]

### **Jacquard Fabrics on Demand**

We are developing a color imaging system to streamline design and production of tailor-made jacquard fabrics for quick response to consumer demand. (Donaldson) [F03-NS03s]

### **Coated and Laminated Fabrics for Fuel Cells**

We are developing a fundamental understanding of the coating and laminating needs of membrane-based fuel cell components to increase efficiency and optimize process. (Adanur with UMassD) [F04-AE01]

### **Fibrous Micro-Electro-Mechanical-Systems (MEMS)**

We are developing a fundamental understanding of fiber elasticity, strength and near fatigue-free behavior at sub-millimeter scales of common MEMS structures such as cantilevers. (Netravali) [F04-CR02]

### **Frequency Effect on Drawing Behavior of Staple Fiber Strands**

To improve staple yarn quality, we seek to understand the beneficial effects of high frequency undulating waves in strand drafting processes. (Wang with UC Davis) [F04-GT01]

### **Superdraw Processing of Hollow Fibers**

We seek to understand the relationship of processing parameters to longitudinal and circumferential deformations during amorphous drawing (superdrawing) of hollow fibers. (Wang) [F04-GT02]

### **Micro-Flow in Textiles**

We are using the combined approach of computational fluid dynamics and magnetic resonance microscopy to investigate momentum and mass transport within textiles. (Leisen with Niederrhein Univ.) [F04-GT05]

### **Compact Fiber-Based Bioconversion/Biofiltration Systems**

We are developing the fundamental understanding to design flocked fabrics for optimal bioconversion/biofiltration activity in the detoxification of polluted water. (Kim) [F04-MD11]

### **Fracture Toughness of Through-Thickness Reinforced Composites**

We are developing fabric layered organic polymer engineering composite (OPEC) materials with improved interlaminar shear strength. (Rice with MIT, US Army) [F04-MD12]

### **Printing Electric Circuits onto Non-Woven Conformal Fabric Substrates**

We are developing technology to print flexible electronic circuit boards onto nonwoven surfaces which are custom designed to allow controlled diffusion of conductive inks. (Pourdeyhimi) [F04-NS17]

## **Single-Step Protein Surface-Attachment to Electrospun Fibers**

By electrospinning conventional synthetic polymers with novel synthetic-bioorganic hybrid copolymers, we aim to produce fibers with specific bioactive surface functionalities. (Spontak with Max Plank) [F04-NS26]

### **Chemistry**

*Research in chemical applications to, and modifications of, fibers and fiber substrates, including dyeing, finishing and waste reduction.*

## **Using Dense Gas Fluids to Improve Chemical Processing**

We are using dense gas fluids, such as CO<sub>2</sub>, to improve selectivity, reaction rate and control in durable finishing, morphology modification and coloration processes for fibers. (Drews) [C01-CL01]

## **Dyeable Polypropylene via Nanotechnology**

We are infusing nanoparticles, such as nanoclays modified with quaternary ammonium salt, into polypropylene fibers to create dyesites for lower cost dyeings in apparel fibers. (Fan) [C01-MD20]

## **Thermally Stable Textile Processing Aids**

We are developing a methodology that will enable us to predict and improve the thermal stability of textile processing aids. (Grant) [C01-NS08]

## **Biomimicking of Enzymes for Textile Processing**

By applying fundamental principles of biology, materials sciences and engineering to natural biochemical processes, we seek to biomimic these processes by simpler chemical means. (Buschle-Diller) [C02-AE02]

## **Pressure Washing of Textiles to Save Water and Effluent**

We are studying the feasibility of using continuous, pulsed and aerated pressure washing of fabrics as a way to significantly reduce rinse water and effluent. (Gowayed)[C02-AE08]

## **Textiles that Protect Wearers from Biological and Chemical Hazards**

We are developing radical grafting polymerization as a way to provide disinfecting and detoxifying agents to textile surfaces, particularly for self-decontaminating protective clothing. (Sun with Auburn) [C02-CD06]

## **Textile Ink Jet: Drop Formation and Surface Interaction**

We are studying the fundamental mechanisms of drop formation and drop/surface interaction in the regimes characteristic of textile ink jet printing. (Carr) [C02-GT07]

## **Biomimetic Decolorization of Mill Effluent**

We are building nanofactories from grafted porphyrin-based catalysts and singlet oxygen chemistries to destroy organic material, such as dyes, in textile/carpet mill effluent. (Bottomley with Emory,NC St)[C02-GT09]

## **One-Step Fabric Formation and Coloration**

We are using cyclodextrins that function simultaneously as warp sizes and latent colorants to combine the weaving and the ink jet printing steps. (George with NC State) [C02-PH03]

## **Nano-Porous Ultra-High Specific Surface Fibers**

By producing nanometer size pores in electrospun ultra-fine fibers we are creating fibers with very high surface area to mass ratios for a variety of uses. (Hsieh with UMassD, Natick) [C03-CD01s]

## **Universal Set of Dyes for Digital Inkjet Textile Printing**

Using new technology to rapidly design new molecules, we are creating a universal set of dyes and chemicals that enable inkjet printing on chemically diverse textile materials. (Ujiie) [C03-PH01]

## **Nano-Porous Ultra-High Specific Surface Fibers**

See [proposal](#) or upcoming initial report in June 2005 Research Briefs (Hsieh with UMassD, Natick) [C04-CD06s]

## **Ultrahydrophobic Fibers: Lotus Approach**

By biomimicing the hydrophobicity and miniature protrusions on lotus leaves, we are developing ultrahydrophobic fibers with excellent water repellency and self-cleaning ability. (Luzinov with Clarkson) [C04-CL06]

## **Ionic Crosslinking - A Novel Method of Fabric Stabilization**

To replace formaldehyde-based crosslinking agents, we are developing ionic ones that provide outstanding wrinkle recovery and strength retention, but do not release carcinogens. (Smith) [C04-NS01]

## **Static Generation and Control in Textile Systems**

By developing a fundamental understanding of static generation on low energy polymer surfaces, we aim to improve fiber processing and minimize unwanted end use static. (Seyam with Western Ontario) [C04-NS07]

## **Optimizing Color Control Throughout the Textile Supply Chain**

We are developing an integrated color control system that optimizes color models and methods to enable effective digital color communication throughout the textile supply chain. (Hinks) [C04-NS11]

## **Genetic Algorithms in Molecular Design of Novel Fibers**

We are developing an extensive structure-property database to aid in designing fibers with improved properties, such as stretch, strength, bulk, comfort and dyeability. (Sztandera with Cornell, Oxford) [C04-PH02s]

## ***Systems***

*Research in the management of product design, sourcing, production, distribution and consumption systems.*

## **Web-Based System to Track How Consumers Express Lifestyles**

We are researching how consumer constellation theory allows consumers to jointly express desired lifestyles across product categories, such as apparel and home furnishings. (Solomon with Berry College) [S01-AC21]

## **Redefining the Apparel Consumer**

We are developing a stable, precise and relevant measure of consumer types based solely on how they acquire and use clothing and independent of demographics. (Brannon) [S01-AC25]

## **Virtual Fit Models Via Body Scan Analysis**

By understanding body scan data, we seek to develop virtual fit models and slopers for mass produced apparel based on body shape, posture and weight distribution. (Connell with Cornell, [TC]<sup>2</sup>, Nottingham Trent) [S01-AC27]

## **Design-Oriented Fabric Comfort Model**

From modeling/analyses of fabric/skin interactions and existing “comfort” fabrics, we are developing “virtual intimacy” measures for comfort to replace intimacy of touch. (El Mogahzy with NC St, GaTech) [S01-AE32]

## **Using Body Scan Data to Improve Garment Fit**

We are providing insights into body/apparel relationships with the ultimate goal of developing a tool for apparel companies to improve their sizing systems. (Ashdown with Fashion Inst of Tech) [S01-CR01]

## **Business-to-Business (B2B) Collaboration in a Softgoods E-Supply Chain**

We are providing models and prototype tools to support collaborative efforts in the business-to-business (B2B) environment. (King) [S01-NS01]

## **Emerging Apparel Supply Chain Configurations**

We are developing a model that not only can optimally schedule a process, but link the apparel production processes together and form a supply chain with distinct operating characteristics. (King) [S01-NS10]

### **3-D Imaging of Fabrics from On-Line Yarn Data**

We are developing a control system for electronically imaging the quality attributes of fabric directly from on-line yarn data. (Suh) [S01-NS12]

### **On-Line Weight and Shrinkage Control of Cotton Knits**

We developed an on-line system that uses image analysis during the knitting process to predict knitted fabric defects much faster than human experts and with greater accuracy. (Abou-iiana with Auburn) [S01-PH07]

### **Fuzzy Forecasting Model for Apparel Sales**

Incorporating climate/temperature data with daily point-of-sale data, we are using fuzzy logic principles to develop new forecasting models for apparel sales. (Frank with Cal St Polytech Pomona) [S01-PH10]

### **Optimal Investment Strategies for Enhanced Productivity**

To increase the U.S. textile industry's market share, we are identifying investment strategies that maximize manufacturing productivity. (Christoffersen) [S01-PH13]

### **Modeling Consumer Behavior in On-line Environments**

We are developing a model to predict on-line adoption of consumer search and purchase behaviors for textile and apparel products. (Forsythe) [S02-AC23]

### **Strategic Model for Functional Protective Clothing**

We developed a way to provide durable biocidal properties to Nomex<sup>®</sup> protective uniforms that are refreshable by commercial laundering without loss in thermal or mechanical properties. (Sun) [S02-CD01]

### **Optimizing the Textile Complex Value Chain**

By measuring buyer and seller perceptions of value of competing purchase options from country to country, we are developing value chain models for the textiles complex. (Rucker w. CalStPolytechPomona)[S02-CD02]

### **Sensory Science: Interactions in Textile Evaluations**

We are developing a fundamental understanding of the social, cultural and physical factors that interact to shape human sensory responses to textiles. (Kaiser with U of Delaware) [S02-CD04]

### **Knowledge Management Across the Value Chain for Competitive Advantage**

We seek to understand how passive and proactive knowledge management systems across the textile and apparel value chain can impact competitive advantage. (Solomon with Berry College) [S03-AC01]

### **Reducing the Bullwhip Effect**

We have solved exactly the equations in the retail apparel supply chain for inventory balance, work in process and ordering policy; no approximations are required. (Warburton with St. Joseph's Univ.) [S03-MD13s]

### **Sustainable Environmental Practices for Competitive Advantage**

We are developing a model to determine which sustainable practices (resource usage, waste reduction) can most reduce costs and increase quality and sales, particularly in the carpet industry. (Rusinko) [S03-PH01]

### **Improving Competitiveness of the U.S. Textile and Apparel Complex**

We are developing a model that will optimize labor/capital ratios and energy resources and measure the impact of trade agreements and foreign competition. (Datta with NC State) [S03-PH02]

### **Apparel Product Development for Plus-Sized Tween Girls**

We are profiling the body shapes, social-psychological dimensions and apparel needs of the emerging niche market of overweight and obese girls aged 9-14. (Connell/Ulrich with [TC]<sup>2</sup>) [S04-AC01]

### **Effects of Carpets on Posture Steadiness and Locomotion Stability**

We are investigating how biomechanical and ergonomic factors affect postural steadiness and locomotion stability and relieve human fatigue on textile floor coverings. (Pan with Georgia Tech) [S04-CD03]

## Improved Apparel Sizing: Fit and Anthropometric 3-D Scan Data

We are developing a tool whereby apparel firms can interpret and apply body scan data to develop their pattern making, grading and sizing systems. (Ashdown with Fashion Inst of Technology) [S04-CR01]

## Quantifying the Value of Information in a Supply Chain

We are developing ways to quantify the value of information sharing in a supply chain (e.g. inventory levels, demand forecasts) to improve intelligent decisions regarding operation of that chain. (King) [S04-NS02]

### ***Guide to NTC Project Numbers (XNN-YYnns) where ...***

X = first letter of the competency

NN = last two numbers of the NTC fiscal year (May to April) when the project was first funded

YY = university:

AC = Auburn Consumer Affairs (was A)

AE = Auburn Textile Engineering (was A)

CL = Clemson (was C)

CD = U Cal-Davis (was E)

CR = Cornell (was B)

GT = Georgia Tech (was G)

MD = U Mass Dartmouth (was D)

PH = Philadelphia U. (was P)

NS = North Carolina State (was S)

nn = number assigned by university to project

s (if present) = seed project

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### **Principal Investigators, Operating Board, Site Directors, Staff:**

- **Bios, Photos, E-mail, etc...** see [http://ntcresearch.org/PDF\\_BIO\\_index.htm](http://ntcresearch.org/PDF_BIO_index.htm)

Biographies for everyone who has ever been an NTC principal investigator include title, institution, academic degrees, experience, research interests, E-mail address, telephone number, personal web site address and all NTC projects they worked on (FY2001 projects renumbered per below).

## ***NTC Annual Reports by Project Management***

### **Auburn University (Consumer Affairs) Management**

#### **On-Line Measurement, Analysis and Feedback System**

(Solomon with Berry College)..... S01-AC21 (I01-A21)

#### **Validity and Reliability in Measuring the Dimensions of Apparel Behavior**

(Brannon)..... S01-AC25 (I01-A25)

#### **Body Scan Analysis for Virtual Fit Models**

(Connell with Nottingham Trent, [TC]<sup>2</sup>, Cornell)..... S01-AC27 (I01-A27)

#### **Modeling Consumer Behavior in On-line Environments**

(Forsythe)..... S02-AC23 (I02-A23)

#### **Knowledge Management as Competitive Advantage in the Textile and Apparel Value Chain**

(Solomon with Berry College)..... S03-AC01

#### **Apparel Product Development for the Plus-Sized Tween and Teen Market**

(Connell with [TC]<sup>2</sup>) ..... S04-AC01

### **Auburn University (Engineering) Management**

#### **Magnetic Ring-Spinning - Revolutionizing the Tradition**

(Abdel-Hady)..... F01-AE02 (F01-A02)

#### **Developing a Design-Oriented Fabric Comfort Model**

(El Mogahzy with Georgia Tech, NC State) ..... S01-AE32 (I01-A32)

#### **Biomimicking of Enzymes for Textile Processing**

(Buschle-Diller) C02-AE02 (C02-A02)

#### **Assessment of Continuous, Pulsed and Aerated Pressure Washing**

(Gowayed)..... C02-AE08 (C02-A08)

#### **Textile Prostheses for Vascular Applications**

(Adanur with UMassD, Emory).... F03-AE02

#### **Coated and Laminated Fabrics for Fuel Cells**

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**The Chemistry of Functional Finishing: Self-decontaminating Textile**

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**A Strategic Model for Functional Protective Clothing** (Sun)..... S02-CD01 (I02-E01)

**A Model for Optimizing the Textile Complex Value Chain**

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**Sensory Science: Social and Physical Interactions in Textile Evalua-**

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**Transport Phenomena in Fibrous Substrates: Liquid and Solid Interac-**

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**Functional Fibers for Immobilization of Biomolecules**

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**Nano-Porous Ultra-High Specific Surface Fibers**

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**Nano-Porous Ultra-High Specific Surface Fibers**

(Hsieh with UMassD, Natick)..... C04-CD06s

**Liquid Wetting and Flow in Nano-Fibrous Systems: Multi-scale and**

**Heterogeneous** (Hsieh with TRI)..... M04-CD01

**Effects of Textile Floor Coverings on Posture Steadiness and Loco-**

**motion Stability** (Pan with Georgia Tech)..... S04-CD03

**Novel Textile Chemistry for Dense Gas Fluids** (Drews with NC State) C01-CL01 (C01-C01)

**Nonlinear Dynamics of High Speed Transport for Staple Yarns**  
(Goswami with U. of Sydney)..... F01-CL04 (F01-C04)

**Novel Polymeric Optical Fibers, Fiber Amplifiers, and Lasers**  
(Ballato) ..... M01-CL01 (M01-CL01)

**Hybrid Polymer Nanolayers for Surface Modification of Fibers**  
(Luzinov with Iowa State) ..... M01-CL03 (M01-C03)

**Dynamic Color Change Chameleon Fiber Systems**  
(Gregory with Furman, Georgia Tech)..... M01-CL07 (M01-C07)

**Biomimetic Manufacturing Of Fibers: Materials Development**  
(Ellison) ..... M02-CL04 (M02-C04)

**Photonic Crystal-Based Polymer Optical Fibers** (Brown) ..... M02-CL06 (M02-C06)

**Functional Fabric with Embedded Nanotube Actuators/Sensors**  
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**Distributed Sensors and Actuators via Electronic-Textiles** (Jalili) .....M04-CL05

**Poly(lactic acid) Derived Fibers with Enhanced Performance**  
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**Surface Modification of CSM Fibers Using Branched Additives** (Hirt with  
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**Cellular Encapsulation into Porous Alginate Fibers**  
(Brown with Rhode Island).....M04-CL13

## **Cornell University Management**

<b><u>"Green" Composites from Cellulose Fabrics &amp; Soy Protein Resin</u></b> (Netravali).....	F01-CR01 (F01-B01)
<b><u>Use of Body Scan Data to Design Sizing Systems Based on Target Markets</u></b> (Ashdown with Fashion Inst of Technology).....	S01-CR01 (I01-B01)
<b><u>Biodegradable Hydrogel-Textile Hybrid for Tissue Engineering</u></b> (Chu with Binghamton).....	M01-CR01 (M01-B01)
<b><u>Improving the Understanding and Acceptance of Personal Protective Equipment</u></b> (Obendorf) .....	M01-CR02 (M01-B02)
<b><u>Biologically Active Bioabsorbable Fibers for Biomedical Uses</u></b> (Chu with UTenn).....	M03-CR04
<b><u>Fibrous Micro-electro-mechanical-systems (MEMS)</u></b> (Netravali) .....	F04-CR02
<b><u>Improved Apparel Sizing: Fit and Anthropometric 3D Scan Data</u></b> (Ashdown with Fashion Inst of Technology) .....	S04-CR01

**Analysis and Enhancement of Carding and Spinning**

(Wang with Clemson)..... F01-GT06 (F01-G06)

**Fundamentals of High Modulus, High Tenacity Melt Spun Fibers**

(Michielsen)..... M01-GT01 (M01-G01)

**In-Situ Synchrotron Study during Fiber Processing**

(Jacob with SUNY-StoneyBrook, UMass Amherst, Ohio State)..... M01-GT04 (M01-G04)

**Textile Ink Jet: Drop Formation and Surface Interaction** (Carr)..C02-GT07 (C02-G07)

**Color Destruction in Mill Effluent via Biomimetic Methods**

(Bottomley with Emory).....C02-GT09 (C02-G09)

**Compressive Behavior of Fiber Assemblies** (Jacob) .....F02-GT04 (F02-G04)

**Frequency Effect on Drawing Behavior of Staple Fiber Strands** (Wang)

with UCDavis) ..... F04-GT01

**Analysis of the Superdraw Process of Hollow Fibers** (Wang) ..... F04-GT02

**Micro-Flow in Textiles** (Leisen with Niederrhein Univ.)..... F04-GT05

**Nano Scale Polymerization and Fiber Spinning** (Jacob with Ohio St) .....M04-GT11

**Terahertz Properties of Textiles: Metamaterials, Sensors, and Security**

(Citrin).....M04-GT19s

**Textile Fibers Engineered From Molecular Auxetic Polymers** (Griffin) ....M04-GT21

## **University of Massachusetts at Dartmouth Management**

<a href="#"><u>Dyeable Polypropylene via Nanotechnology</u></a> (Fan with UNL) .....	C01-MD20 (C01-D20)
<a href="#"><u>Electrostatic Spinning and Properties of Ultrafine Fibers</u></a> (Rutledge, M.I.T., with UMassD).....	M01-MD22 (M01-D22)
<a href="#"><u>Nano Engineered Fire Resistant Composite Fibers</u></a> (Patra with Auburn).....	M02-MD08 (M02-D08)
<a href="#"><u>Electro-Static Web Formation</u></a> (Kim with NC State).....	F03-MD01
<a href="#"><u>Bio-active Bandages</u></a> (Bhowmick with Harvard).....	F03-MD15
<a href="#"><u>Nano Crafted Layered Optical Filaments for Diffractive Colors</u></a> (vert with Clemson) .....	(Cal- M03-MD14
<a href="#"><u>An Analytical Investigation of the Bullwhip Effect</u></a> (Warburton with St. Joseph's Univ.) .....	S03-MD13s
<a href="#"><u>Compact Fiber-Based Bioconversion/Bio-filtration Systems</u></a> (Kim with Mass. Maritime) .....	F04-MD11
<a href="#"><u>Fracture Toughness of Through-Thickness Reinforced Composites</u></a> (Rice with MIT, US Army).....	F04-MD12
<a href="#"><u>Quantum Tunneling Nanocomposite Textile Soft Structure Sensors and Actuators</u></a> (Patra) .....	M04-MD07

### **Improving the Thermal Stability of Textile Processing Aids**

(Grant)..... C01-NS08 (C01-S08)

### **Applications of Micromachines in Fabric Formation** (Seyam)..... F01-NS14 (F01-S14)

### **Modeling of Thermal Protection Outfits for Fire Exposures**

(Barker)..... F01-NS50 (S01-NS02/I01-S02)

### **Lewis Acid-Base Complexation of Polyamides** (Kotek with TRI) ... M01-NS03 (M01-S03)

### **Business-to-Business Collaboration in a Softgoods E-Supply Chain**

(King) ..... S01-NS01 (S01-S01)

### **Emerging Apparel Supply Chain Configurations** (King) ..... S01-NS10 (I01-S10)

### **3-D Electronic Imaging of Fabric Qualities by On-Line Yarn Data**

(Suh) ..... S01-NS12 (I01-S12)

### **Development of Layered Functional Fiber-based Microtubes**

(Ghosh)..... F02-NS05 (F02-S05)

### **3-D Virtual Draping with Fabric Mechanics and Body Scan Data**

(May-Plumlee) ..... F02-NS08 (F02-S08)

### **Polymers Processed with Cyclodextrin Inclusion Compounds**

(Tonelli with Ga Tech)..... M02-NS01 (M02-S01)

### **Jacquard Fabrics on Demand** (Donaldson) ..... F03-NS03s

### **Ionic Crosslinking - A Novel Method of Fabric Stabilization** (Smith) ..... C04-NS01

### **Static Generation and Control in Textile Systems**

(Seyam with Western Ontario) ..... C04-NS07

### **Optimizing Color Control Throughout the Textile Supply Chain** (Hinks) C04-NS11

### **Printing Electric Circuits Onto Non-Woven Conformal Fabric Sub-**

**strates** (Pourdeyhimi)..... F04-NS17

### **Single-step Protein Surface-attachment to Electrospun Fibers**

(Spontak with Max Plank)..... F04-NS26

### **Quantifying the Value of Information in a Supply Chain** (King) ..... S04-NS02

## **Philadelphia University Management**

### **On Line Weight and Shrinkage Control of Cotton Knits**

(Abou-iiiana with Auburn) ..... S01-PH07 (I01-P07)

### **A Fuzzy Forecasting Model for Women's Casual Sales**

(Frank with California State Polytechnic - Pomona)..... S01-PH10 (I01-P10)

### **Optimal Investment Strategies for Enhanced Productivity**

(Christoffersen) ..... S01-PH13 (I01-P13)

### **Integration of Fabric Formation and Coloration**

(George with NC State) ..... C02-PH03 (C02-P03)

### **Universal Set of Dyes for Digital Inkjet Textile Printing (Ujjie)..... C03-PH01**

### **Sustainability as a Source of Competitive Advantage (Rusinko)..... S03-PH01**

### **Strategies for Improving the Competitiveness of the U.S. Textile and Apparel Industries (Datta with NC State) ..... S03-PH02**

### **Genetic Algorithms in Molecular Design of Novel Fibers**

(Sztandera with Cornell, Oxford) ..... C04-PH02s

## ***Abbreviations***

The following abbreviations are not always defined in articles.

Auburn (AE, AC): University of Auburn, Auburn AL 36849 [E=TE;C=Consumer]	MAE: Mechanical and Aerospace Engineering	TFPS: Textile, Fiber & Polymer Science
Chem Eng: Chemical Engineering	ME: Mechanical Engineering	TRI: Textile Research Institute (Princeton NJ 08542)
CivE: Civil Engineering	M.I.T.: Mass. Inst. of Technology	UAB: Univ. of Alabama-Birmingham
Clemson (CL): Clemson University, Clemson SC 29634	NC State (NS): North Carolina State University, Raleigh NC 27695	UC-Davis (CD): University of California – Davis, Davis CA 95616-8722
Cornell (CR): Cornell University, Ithaca NY 14853	NMR: nuclear magnetic resonance	UD: University of Delaware
dpf: denier per filament	PET: poly(ethylene terephthalate)	UG: University of Georgia
ESR: electron spin resonance	PhilaU (PH): Philadelphia University, Philadelphia PA 19144	UNC-G: University of North Carolina at Greenville
Fib: Fiber	Poly Sci: Polymer Science	UMassD (D): University of Massachusetts at Dartmouth MA 02747
FTIR: Fourier Transform Infrared	TAM: Textile and Apparel Management	UNL: University of Nebraska at Lincoln
Georgia Tech (GT): Georgia Institute of Technology, Atlanta GA 30332	[TC] <sup>2</sup> : Textile/Clothing Technology Corp	UNO: University of New Orleans
ITT: Institute of Textile Technology, Charlottesville VA 22903-4614	TE: Textile Engineering	U of PA: University of Pennsylvania
LSU: Louisiana State University	Tex: Textile	U of Tenn: University of Tennessee
	TextE: Textile Engineering	URI: Univ. of Rhode Island
	TFE: Textile and Fiber Engineering	

## ***Discontinued Projects***

[ordered by year, then competency, then University]

The following NTC projects were discontinued because they successfully completed their maximum three-year life span (or one-year for seed projects) or because other research was of higher priority. For their last report, see the NTC website at <http://www.ntcresearch.org>, the [June 2003 NTC Research Briefs](#) or the [November 2003 NTC Annual Report](#).

You may also contact the principal investigators whose phone numbers and E-mail addresses are listed therein.

New projects often grew out of completed projects (See the notes following the listings below for any new projects).

### **Abrasion Resistance of Durable Press Cotton**

(Lickfield with Georgia) ..... C00-CL01 (C00-C01)

### **Quantum Dots As Dyes And As Optical Brighteners For Fibers**

(Srinivasarao)..... C00-GT03 (C00-G03)

### **COS and HTS Design of High-Performance, Nontoxic Chemicals**

for Textiles (Bhat) ..... C00-PH01 (C00-P01)

### **Substrate-Coating Interaction in Coated Fabrics**

(Chen, UMass Lowell, with UMassD, Georgia Tech, UCal-Davis) ... F00-MD06 (F00-D06)

### **Architectural Fabric Structures: Exploration, Modelling and Implemen-**

**tation** (Messinger)..... F00-PH01 (F00-P01)

### **Engineered Non-Linear Elastic Blended Fabrics**

(Pastore with Auburn)..... F00-PH05 (F00-P05)

### **Intelligent Textiles based on Environmentally Responsive Fibers**

(Foulger) [see M01-CL03, M02-CL06] ..... M00-CL07 (M00-C07)

### **Development of Bio-Active Fabrics**

(Fowler with Harvard) [see F03-MD15] ..... M00-MD03 (M00-D03)

**Nanocomposite Fibers** (Kim with Arizona) [see M03-MD14] ..... M00-MD08 (M00-D08)

### **Fabric Design and Analysis System in 3-D Virtual Reality**

(Adanur with Georgia Tech) ..... S00-AE06 (I00-A06)

### **Automated Garment Development from Body Scan Data**

(Carrere) ..... S00-NS15 (I00-S15)

### **Haptic Simulation of Fabric Hand**

(Govindaraj with Rutgers,California State Polytechnic) ..... S00-PH08 (I00-P08)

### **The Role of Emotion in Success of Global Retailing**

(Kim with Dong Hwa, Oklahoma St) .....S01-AC31 (I01-A31)

### **Combining Theory of Constraints and Speech Act Theory for Constraint Based Coordination of New Product Development**

(Winchester)..... S01-NS09 (I01-S09)