NTC Research Briefs 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 Research Brief 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 Research Brief, in the 2005 Annual Report, on the web at http://www.ntcresearch.org/current/FY2005/FY2005_proj.htm or on the latest CD. You can keyword search and view all NTC Reports ever published at http://ntcresearch.org and also view all reports on the CD.

To contact any principal investigator, see their bio following each Research Brief for their email address, phone, website 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 and/or on the latest CD/ROM.

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NTC Research Briefs by Competency Groups

Materials

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

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 understanding the structures needed to print interference colors on textiles, we can enable new sensors and fabrics that can reflect or transmit light for optimal cooling or warming. (Calvert) [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 Long Island U.) [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 U. of Rhode Island) [M04-CL13]

Nano Scale Polymerization and Fiber Spinning

Using “extrusion polymerization” through mesoporous silica channels, we are producing highly crystalline nylon and polyester nanofibers with exceptional mechanical properties. (Jacob with Ohio St) [M04-GT11]

Textile Fibers Engineered from Molecular Auxetic Polymers

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

Quantum Tunneling Nanocomposites as Sensors and Actuators in Fabric

We are using piezoresitivity arising from quantum tunneling in conducting polymer nanocomposites to make printable stress sensors and actuators for textiles. (Patra) [M04-MD07]

Efficient Biological-Chemical Protective Materials

We are developing the fundamental knowledge to design "breathable" fabrics that also provide barrier protection from biological and chemical hazards. (Gowayed with Clemson) [M05-AE11]

Functional Fibers via Biomimesis

We are developing a fundamental understanding of how liquid wets and flows in nanoporous fibers and nanofibrous substrates. (Hsieh with Clemson, Natick) [M05-CD01]

New Cellulose Engineering Materials

We are developing a fundamental understanding of the cellulose dissolution process to create a new class of cellulose engineering materials. (Frey with NC State) [M05-CR02]

Shape Memory Polymer Fibers for Comfort Wear

We are using chemical and mechanical shape memory effects to develop fibers that change their shape in response to external stimuli, e.g. temperature, for enhanced fabric comfort. (Cook with NC State) [M05-GT14]

High Modulus Aliphatic Nylon Fibers via Lewis-Acid Complexation

By forming a Lewis acid - nylon 66 complex to reduce hydrogen bonding during drawing, we have produced high melting, ultra-high modulus and high strength fibers. (Kotek with Long Island U.) [M05-NS05]

Fabrication

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

Textile Prostheses for Vascular Applications

We are exploring the application of textile structures as stents. (Adanur with UMassD, Emory) [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 developing bandages that contain growth factors which will accelerate wound healing. (Bhowmick with Harvard) [F03-MD15]

Coated and Laminated Fabrics for Fuel Cells

We are studying gas diffusion layers to find new ways to improve their performance in fuel cells. (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

We are developing the knowledge base to enhance the strand drafting process by minimizing drafting waves in staple yarn manufacturing. (Wang with UCDavis) [F04-GT01]

Superdraw Processing of Hollow Fibers

We seek to understand the fundamental principles of superdrawing, and to study its application to hollow fiber production. (Wang with East Carolina U.) [F04-GT02]

Micro-Flow in Textiles

Magnetic Resonance Imaging and Computational Fluid Dynamics provide a detailed insight into flow phenomena in textiles. (Leisen with Niederrhein Univ.) [F04-GT05]

Compact Fiber-Based Biofiltration Systems

We are developing highly efficient, fiber-based bioconversion media for use in the detoxification of ammonia-contaminated water. (Kim) [F04-MD11]

Fracture Toughness of Through-Thickness Reinforced Composites

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

Printing Electric Circuits onto Non-Woven Conformal Fabric Substrates

We are developing technology to print flexible electronic circuits and sensor systems onto nonwoven surfaces which are custom designed and fabricated with textile processing technologies. (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]

Reinforcement Fabrics with Electronic Transmission Capabilitity

We are developing fundamental knowledge to understand how to design geotextile roadbed liners embedded with antennae and electronic transmission capability. (Thomas) [F05-AE13]

Demand Activated Toughening in Ballistic Protective Garments

To design comfortable, ballistic protective garments, we are developing understanding of shock-induced chemical reactions that convert flexible polymers to hard ceramic materials. (Jacob with Auburn) [F05-GT04]

Melt Electrospinning Route to Cost-Effective Nanofibers

We are developing an electrospinning process from melt polymer with prospects of higher productivity and without the costly solvent recovery step of solvent electrospinning. (Warner with NJIT) [F05-MD01]

Robospiders for Spinning Strong Sub-Micron Fibers

We are developing an understanding of the rheology and kinetics with real-time feedback control needed to pultrude minute quantities of strong, sub-micron, fibrous materials for medical uses. (Calvert) [F05-MD09]

Electrospun Core-Sheath Fibers for Engineering Soft Tissues

We are developing novel bi-component nanofiber structures, using natural and synthetic biodegradable polymers that could be used as scaffolds for engineering soft tissues. (Gupta) [F05-NS04]

Scent-Infused Textiles to Enhance Consumer Experiences

We are developing polymer fibers that incorporate effective, long-lasting fragrances for innovative and marketable textiles and to measure their psychology of acceptance. (Pierce) [F05-PH03]

Chemistry

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

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]

Ultrahydrophobic Fibers: Lotus Approach

By biomimicing the hydrohobicity and miniature protrusions on lotus leaves, we are developing ultrahydrohobic 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

We are seeking fundamental understanding of static generation/control on polymer surfaces in terms of processing parameters, ambient conditions, polymer type and finish. (Seyam with Western Ontario) [C04-NS07]

Optimizing Color Control Through the Textile Supply Chain

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

Molten Organic Salts as Solvents for Fiber Extrusion

We are investigating using molten organic salts as solvents for the extrusion of stiff and/or polar materials, including cellulose. (Broughton with U. of Alabama) [C05-AE05]

Textiles with Highly Selective Receptors for Specific Molecules

By molecular imprinting polymers on fibers, we are designing novel functionalities with molecular recognition capability for molecular separation, isolation, immobilization and sensing uses. (Luzinov) [C05-CL01]

Microporous Membranes for Comfortable Protective Clothing

We are developing hybrid microporous membranes for protective clothing which restrict liquid/pathogen penetration, yet allow water vapor to diffuse out from skin for comfort.(Obendorf with UC Davis)[C05-CR01]

High-Yield Application of Permanent Colorants

We are incorporating functional groups into textile colorants and finishes to increase add-on and permanency via subsequent *in situ*, thermally-induced, covalent bond formation. (Beckham) [C05-GT04]

Inkjet Deposition of Complex Mixtures to Textiles

We are developing a fundamental understanding of the process of deposition of complex mixtures by the inkjet method. (Carr with CCNY) [C05-GT07]

Boundary Lubrication and Molecular Assembly

We are elucidating the nature of the boundary layer (e.g. finish) adsorbed on fiber surfaces, that controls wear and friction during textile processing. (Rojas with Cornell, UC Santa Barbara) [C05-NS09]

Using Genetic Algorithms in Molecular Design of Fibers

Using artificial intelligence techniques, we are designing polymer formulations with specified properties, such as stretch, strength, bulk, comfort and dyeability. (Sztandera with Cornell, Oxford) [C05-PH01]

Systems

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

Knowledge Management Across the Value Chain for Competitive Advantage

We are developing management tools for industry to increase their retention and retrieval of knowledge, to decrease cycle time and to add product value via consumer input. (Solomon with Berry College) [S03-AC01]

Sustainable Environmental Practices for Competitive Advantage

We developed a model that seeks to optimize labor/capital ratios and energy resources and measures the impact of trade agreements and foreign competition. (Rusinko) [S03-PH01]

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

We developed a model that seeks to optimize labor/capital ratios and energy resources and measures the impact of trade agreements and foreign competition. (Datta with NC State) [S03-PH02]

Apparel Product Development for Plus-Sized Tween Girls

With body scan, social-psychological and behavioral data, we seek to improve garments and sizing for overweight and obese girls aged 9-14 to improve their social interactions. (Connell/Ulrich with $[TC]^2$)[S04-AC01]

Effects of Carpets on Posture Steadiness and Locomotion Stability

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

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

We are providing insight into body/apparel relationships using body scan data to develop research and analysis protocols that will improve apparel fit of firm sizing systems. (Ashdown with UC Davis) [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]

Masculine Fashion Choices: Shifting Identities

We aim to understand how the shifting male consumer culture thinks about fashion and lifestyle issues and how men evaluate and purchase clothing. (Solomon with Berry, UC Davis, Delaware, Cornell) [S05-AC02]

Fabric/Skin Interactions: Contact, Friction and Dynamic Motion

We are developing multi-scale models of physical and physiological interactions between fabric and skin, such as contact and friction, and the impact of dynamic motion (e.g. walking). (Pan with UCSF) [S05-CD04]

Hispanic Characterization System

This is the first comprehensive, empirical research system designed to generate a multidimensional profile of the U. S. Hispanic market in terms of textile and apparel needs and preferences. (Jones) [S05-NS04]

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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Auburn University (Engineering) Management

University of California at Davis Management

Clemson University Management

Cornell University Management

Georgia Institute of Technology Management

University of Massachusetts at Dartmouth Management

North Carolina State University Management

Philadelphia University Management

Abbreviations

The following abbreviations are not always defined in articles.

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

Discontinued Projects

[ordered by University, then competency, then year]

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 2005 ***NTC Research Briefs*** (links below) or the November 2005 ***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).

Biomimicking of Enzymes for Textile Processing (Buschle-Diller) C02-AE02 (C02-A02)

We are investigating the possibility of biomimicking the catalytic function of the active site of oxidoreductase enzymes by simpler compounds without the greater part of the protein.

Assessment of Continuous, Pulsed and Aerated Pressure Washing

(Gowayed) C02-AE08 (C02-A08)

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.

Textiles that Protect Wearers from Biological and Chemical Hazards

(Sun with Auburn) C02-CD06 (C02-E06)

We are developing radical grafting polymerization as a way to provide disinfecting and detoxifying agents to textile surfaces, particularly for self-decontaminating protective clothing.

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

We are studying the fundamental mechanisms of drop formation and drop/surface interaction in the regimes characteristic of textile ink jet printing.

Color Destruction in Mill Effluent by Biomimetic Methods

(Michielson with Emory, NC State) C02-GT09 (C02-G09)

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.

Integration of Fabric Formation and Coloration

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

We are using cyclodextrins that function simultaneously as warp sizes and latent colorants to combine the weaving and the ink jet printing steps.

Nano-Porous Ultra-High Specific Surface Fibers

(Hsieh with UMassD, Natick) C04-CD06s

Via electrospinning, we have produced ultra-high specific surface nanofibers by creating roughened surfaces and nano-porous structures.

Genetic Algorithms in Molecular Design of Novel Fibers

(Sztandera with Cornell, Oxford) C04-PH02s

We are developing an extensive structure-property database to aid in designing fibers with improved properties, such as stretch, strength, bulk, comfort and dyeability.

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

We are characterizing compressive behavior of fiber assemblies with a combination of modeling and experimental techniques.

Development of Layered Functional Fiber-based Microtubes

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

We are exploring the technological potential of submicron diameter tubing of electroactive polymeric materials for applications in sensing and actuation.

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

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

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.

Transport Phenomena in Fibrous Substrates: Liquid and Solid Interactions **(Pan with Cornell)** ..... **M02-CD03 (M02-E03)**

From microscopic liquid and solid interactions, we are developing stochastic models to predict liquid transport behavior in fibrous substrates.

Functional Fibers for Immobilization of Biomolecules

(Hsieh with Natick) ..... **M02-CD05 (M02-E05)**

We are developing processes to chemically activate the surface of fibrous materials for the recovery of biomolecules, such as specialty enzymes, by encapsulation/immobolization.

Biomimetic Manufacturing of Fibers: Materials Development

(Ellison) ..... **M02-CL04 (M02-C04)**

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.

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

Photonic crystal-based fibers could give a new look to fibers, not only for fashion, but for added functionalities.

Nano Engineered Fire Resistant Composite Fibers

(Patra with Auburn) ..... **M02-MD08 (M02-D08)**

We are developing a fundamental understanding of the thermal insulation of heat and fire resistant polymeric composite fibers when embedded with nanoparticle fillers.

Polymers Processed with Cyclodextrin Inclusion Compounds

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

We have developed a fundamental understanding of how cyclodextrin inclusion compounds deliver properties (e.g. flame retardancy, antibacterial, color) to polymers during processing.

Terahertz Properties of Textiles: Metamaterials, Sensors and Security

(Citron) **M04-GT19s**

We are developing textiles that strongly interact with terahertz radiation for range of applications in security, defense, and industry, with a focus on chemical and environmental sensors.

Modeling Consumer Behavior in On-line Environments

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

We are developing a model to predict on-line adoption of consumer search and purchase behaviors for textile and apparel products.

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

We developed a way to provide durable biocidal properties to Nomex® protective uniforms that are refreshable by commercial laundering without loss in thermal or mechanical properties.

A Model for Optimizing the Textile Complex Value Chain

(Rucker with California State Polytechnic - Pomona) ..... **S02-CD02 (I02-E02)**

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.

Sensory Science: Social and Physical Interactions in Textile Evaluations

(Kaiser with U of Delaware) ..... **S02-CD04 (I02-E04)**

We are developing a fundamental understanding of the social, cultural and physical factors that interact to shape human sensory responses to textiles.