



## NETI RESEARCH PROJECTS AND APPLICATIONS



Research Project	Industry Partners	Research Applications	Industry Sectors	Environmental Area
<b>Water-Based Coatings for Cedar Siding: Use of a Lamellar Block Copolymer to Prevent Extraction of Tannins</b> Surita Bhatia, Dept. of Chemical Engineering	<b>Churchill Coatings:</b> Grafton, MA	Applications in water-based coatings for cedar siding, replacing oil-based primers. Oil-based primers are classified as a major source of VOC emissions in Massachusetts.	Wood products, construction, manufacturing	Air toxics, VOC emissions, hazardous waste
<b>Application of Molecular Simulation Techniques to the Design of Poly (hydroxy alkanate) Modified Polyurethanes: Miscibility and Property Control</b> Shaw Ling Hsu, Dept. of Polymer Science & Engineering	<b>Metabolix:</b> Cambridge, MA	Applications in reducing the amount of isocyanates used in the synthesis of high performance polyurethanes.	Automotive, biomedical, manufacturing, chemicals	Hazardous waste, municipal solid waste
<b>Mechanistic Predictions of PAC Pollutant Formation</b> Phillip Westmoreland, Dept. of Chemical Engineering	<b>United Technologies:</b> CT	Application for industrial process monitoring and control to prevent pollutant formation and emissions.	Manufacturing, airlines	Hazardous waste, emissions, air toxics
<b>Fabrication of a Tunable Molecular-Sieve/Polymer Composite Membrane and its Use in Oxygen Enrichment of Air Streams</b> Michael Tsapatsis and H. Henning Winter, Dept. of Chemical Engineering	<b>Engelhard Corp.:</b> NJ	Applications in large scale processing to enable separations of methane/nitrogen, oxygen/nitrogen, and carbon dioxide/methane.	Automotive, manufacturing	Air toxics, NO <sub>x</sub> emissions
<b>Environmentally-Conscious Lubrication for Superfinishing</b> Stephen Malkin, Dept. of Mechanical and Industrial Engineering	<b>Darmann Abrasive Products:</b> Clinton, MA	To reduce dependence on hazardous cutting fluids for superfinishing processes used in manufacturing.	Bearing, automotive, hydraulic & fuel delivery systems and medical implants	Hazardous waste, air toxics
<b>Development of an Adhesion Hydrogel for Ion-Selective QCM Sensors</b> David Hoagland, Dept. of Polymer Science & Engineering	<b>Brim's Ness:</b> ME	Applications in detecting heavy metal and organic contaminants in groundwater and monitoring of process streams and effluents.	Municipalities, water treatment facilities, hospitals, power generation facilities, manufacturing	Hazardous waste, wastewater
<b>Engineering the Chemical Backbone of Rubbers to Aid in Recycling through High Pressure Hot Compaction</b> Richard Farris, Dept. of Polymer Science & Engineering	<b>Rouse Rubber Industries:</b> MS	Applications in recycling tire rubbers into reusable products to reduce the burden of solid waste disposal.	Rubber, recycling	Municipal solid waste
<b>Separation of Close Boiling Hydrocarbon Isomers with Zeolite Composite Membranes</b> Michael Tsapatsis & Scott Auerbach, Dept. of Chemical Engineering	<b>Engelhard:</b> NJ	Production of polyfibers and PET recyclable bottles. Membranes enable chemical separations that result in operating cost savings, reduced energy usage, reduced by-products and elimination of polluting chemicals that are used as solvents.	Plastics, chemicals, drugs, petroleum, recycling	Air toxics, photo-chemical smog, acid rain, climate change, energy demand, hazardous waste, wastewater

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<b>An Environmentally Benign Route for Use of Scrap Polyalkylenes for High Molecular Weight Composite Applications</b> William MacKnight, Dept. of Polymer Science & Engineering	<b>Cyclics Corp.:</b> NY	To increase utilization of scrap polyesters and reduce the solid wastes in plastics industry.	Plastics, recycling	Municipal solid waste
<b>Zero Discharge in the Textile Industry</b> Sarina Ergas & David Reckhow, Dept. of Civil and Environmental Engineering	<b>Morton International, Inc.:</b> Danvers, MA	To reduce wastewater in the textile industry.	Textiles	Water demand, energy demand, wastewater
<b>Supercritical CO<sub>2</sub> for High Performance Fiber Processing</b> Alan Lesser, Dept. of Polymer Science & Engineering	<b>U.S. Army:</b> Natick, MA <b>Aberdeen Research Labs:</b> MD	To produce high performance plastics and carbon-carbon composites.	Plastics, manufacturing, industrial machinery	Photochemical smog, air toxics, wastewater
<b>Waste Minimization Through Integration of Process Design and Process Control</b> Alex Zheng, Dept. of Chemical Engineering	<b>GE Plastics:</b> Pittsfield, MA	Applications in plastics, chemicals, pharmaceuticals and electronics industries.	Chemicals, plastics, drugs, electronics	Air toxics, photochemical smog, climate change, ozone depletion, energy demand, wastewater
<b>Environmentally Benign Products and Processes Based on Homogenous Catalysis</b> Ka Ng, Michael Tsapatsis, Dionisios Vlachos, Phillip Westmoreland & Vincent Rotello, Dept. of Chemical Engineering	<b>Mitsubishi Chemical:</b> Japan <b>Engelhard:</b> IL	Applications for industry suppliers of catalysts (process chemistry) that are used in the manufacture of chemicals, pharmaceuticals, and plastics.	Chemicals, drugs, plastics, petroleum	Air toxics, photochemical smog, acid rain, climate change, energy demand, hazardous waste, wastewater
<b>Solventless Polymer Processing and Synthesis</b> James Watkins, Dept. of Chemical Engineering	<b>Procter &amp; Gamble:</b> OH <b>Alza Corp.:</b> CA	Broad applications for solventless plastics formulations, and polymer coatings for finished metals, pharmaceuticals, and construction material.	Plastics, chemicals, drugs, manufacturing, industrial machinery	Air toxics, photochemical smog, climate change, energy demand, hazardous waste
<b>Green Chemistry, Physics, and Engineering of Polymers</b> Shaw Ling Hsu, Thomas McCarthy, Alan Lesser, William MacKnight, Jacques Penelle & Thomas Russell, Dept. of Polymer Science & Engineering, James Watkins, Dept. of Chemical Engineering	<b>Rexam:</b> South Hadley, MA <b>Loctite:</b> CT <b>Markem:</b> NH <b>Presstek:</b> NH <b>Eastman Kodak:</b> NY <b>Allied Signal:</b> NJ <b>Alza:</b> CA <b>GE Plastics:</b> Pittsfield, MA	Broad applications for solventless plastics formulations, polymers for electronic materials manufacture, surfactants, and polymers for finished metal, plastics, pharmaceutical, and architectural coatings.	Chemicals, drugs, plastics, electronics, manufacturing, dry cleaning, construction, petroleum	Air toxics, photochemical smog, acid rain, climate change, energy demand, hazardous waste, wastewater, municipal solid waste

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<b>Development of Environmentally Conscious Methods for Grinding</b> Stephen Malkin, Dept. of Mechanical & Industrial Engineering	<b>ChandKare Technical Ceramics:</b> Worcester, MA <b>ITW Vortec:</b> OH <b>Norton Co.:</b> Worcester, MA <b>Torrington Co.:</b> CT <b>Landis Gardner:</b> PA <b>General Motors:</b> MI <b>SKF Technical Development Centre:</b> Sweden	Applications in all metal products ranging from small machine and auto shops to large machine and automotive manufacturers.	Manufacturing, industrial machinery, agriculture	Hazardous waste, air toxics
<b>Optimization Polyurethane to Reduce Isocyanate Demand</b> Alan Lesser, Dept. of Polymer Science & Engineering	<b>GI Plastek:</b> Newburyport, MA <b>GE Plastics:</b> NY & Pittsfield, MA <b>Shell Chemical Co.:</b> TX	Applications for polyurethanes used extensively as metal, furniture, and construction coatings.	Manufacturing, furniture, construction, commercial, industrial machinery	Air toxics, hazardous waste
<b>Solventless Polymer Processing and Synthesis</b> James Watkins, Dept. of Chemical Engineering	<b>Procter &amp; Gamble:</b> OH <b>Alza Corp.:</b> CA	Broad applications for solventless plastics formulations, and polymer coatings for finished metals, pharmaceuticals, and construction material.	Plastics, chemicals, drugs, manufacturing, industrial machinery	Air toxics, photochemical smog, climate change, energy demand, hazardous waste
<b>A Novel Thin Film Wheel Microreactor for Partial Oxidation</b> Dionisios Vlachos & Michael Tsapatsis, Dept. of Chemical Engineering	<b>Praxair:</b> NY	Low temperature conversion of methane to oxygenated liquid hydrocarbons leading to reduced greenhouse gas emissions, utilization of methane as a logistic fuel, and low cost production of oxygenated fuel additives and chemical feedstocks.	Energy and petroleum, transportation, chemicals	Climate change, energy demand
<b>Waste Prevention in Metalorganics for Semiconductor Manufacturing</b> Kei May Lau, Dept. of Electrical and Computer Engineering	<b>Morton International:</b> Danvers, MA	Key process in production of custom semiconductors and high temperature superconducting materials for advanced electronic and electro-optic devices.	Electronics, chemicals, industrial machinery	Hazardous waste
<b>Bacterial Production of Polyesters for Pressure Sensitive Adhesives</b> Robert Lenz, Dept. of Polymer Science Steve Goodwin, Dept. of Microbiology	<b>3M:</b> MN	Biodegradable polymers to replace pressure-sensitive adhesives (e.g.: tapes, labels, protective masks) reducing the municipal solid waste burden and increasing the substitution of renewable feedstocks for petroleum.	Chemicals, plastics, manufacturing, agriculture	Municipal solid waste, air toxics, photochemical smog, climate change, energy demand
<b>Human Health Impact of Exposure Reduction in Massachusetts</b> Kenneth Mundt, Dept. of Public Health & Health Sciences	<b>Polaroid Corp.:</b> Waltham, MA	Applications across all industries that use hazardous organic solvents to assess occupational risks of alternative practices	Chemicals, manufacturing, industrial machinery, plastics, electronics, dry cleaning	Air toxics, photochemical smog
<b>Design and Utilization of Elastomeric Energy Storage Devices</b> Richard Farris, Dept. of Polymer Science & Engineering	<b>Globe Manufacturing:</b> Fall River, MA <b>Globe Rubber:</b> Rockland, MA	Alternatives for energy storage that can replace batteries and recover energy during braking in the transportation sector.	Chemicals, manufacturing, industrial machinery, energy and petroleum, transportation	Energy demand, hazardous waste, climate change

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<b>Radiation Curing of Polymers</b> Shaw Ling Hsu & Jacques Penelle, Dept. of Polymer Science & Engineering	<b>Dow Chemical:</b> TX <b>3M:</b> MN	Broad applications in polymers for electronic materials and finished metals, plastics, pharmaceutical, and architectural coatings.	Electronic, chemicals, plastics, drugs, manufacturing, industrial machinery, construction	Air toxics, photochemical smog, climate change, energy demand
<b>Prevention of Solvent Use in Polymer Processing Through Supercritical Fluids</b> H. Henning Winter, Dept. of Chemical Engineering	<b>Daicel:</b> Japan <b>Millipore:</b> Bedford, MA	Broad applications for solventless plastics formulations, and polymers for finished metal, plastic, pharmaceutical, and architectural coatings.	Plastics, chemicals, drugs, manufacturing, industrial machinery	Air toxics, photochemical smog, climate change, energy demand, hazardous waste
<b>Molecular Sieve Membranes: Processing, Microstructure, and Separation Properties</b> Michael Tsapatsis, Dionisios Vlachos & Scott Auerbach, Dept. of Chemical Engineering	<b>Engelhard:</b> NJ <b>BP/Amoco:</b> IL	Applications include separations for solvent recovery in chemicals, textiles, and graphics; in-process separations for improved efficiency in chemicals manufacturing; air separations for improved combustion efficiency and reduced NO <sub>x</sub> formation.	Chemicals, textiles, commercial printing, transportation, energy production	Air toxics, photochemical smog, acid rain, climate change, energy demand, hazardous waste, wastewater
<b>Optimal Design of Multiphase-Reactors for Waste Prevention</b> Ka Ng, Department of Chemical Engineering	<b>Morton International:</b> Danvers, MA <b>Searle:</b> IL <b>Mitsubishi Chemicals America:</b> CA	Methodology can be applied to both homogeneous and multi-phase chemical reactions to reduce unwanted side reactions.	Chemicals, drugs, plastics, petroleum	Air toxics, photochemical smog, acid rain, climate change, energy demand, hazardous waste, wastewater
<b>Kinetics for Controlling NO<sub>x</sub> at the Source</b> Phillip Westmoreland, Dept. of Chemical Engineering	<b>United Technologies Research Center:</b> CT	Improved methodology for predicting NO <sub>x</sub> formation during combustion for improved designs for boilers, gas turbines, and engines resulting in reduced pollution from power generation, combined heat and power, home heating, and transportation.	Petroleum and energy, industrial machinery, manufacturing, transportation	Photochemical smog, acid rain
<b>An Environmentally Benign Route to the Utilization of Scrap Poly(ethylene terephthalate) for Composite Applications</b> William MacKnight & Roger Kambour, Dept. of Polymer Science & Engineering	<b>General Electric Research &amp; Development:</b> NY	Clean methodology for recycling PET (soda bottles) to increase utilization of recycled material reducing municipal solid waste burden while minimizing secondary waste generation.	Plastics, recycling, manufacturing, commercial	Municipal solid waste
<b>Design and Optimization of Batch Solvent Recovery Processes for Waste Prevention</b> Michael Malone, Dept. of Chemical Engineering	<b>Polaroid Corporation:</b> Waltham, MA	Potentially applicable to any collection of batch chemical processes to reduce the cost of solvent recovery.	Chemicals, petroleum, drugs	Air toxics, photochemical smog, climate change, energy demand, hazardous waste, wastewater
<b>Membrane-Based Technologies for Waste Prevention</b> Ka Ng, Dept. of Chemical Engineering	<b>DuPont Central Research and Experimental Station:</b> DE	The technique can be used with a wide variety of aqueous/organic solvent processes that are found in the manufacture of agrochemicals, pharmaceuticals, dyes, and textiles.	Chemicals, plastics, industrial machinery, petroleum, drugs, manufacturing, textiles, commercial printing, electronics, pulp and paper	Wastewater, hazardous waste, air toxics, energy demand, photochemical smog, climate change

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<b>Recycle of VOCs In Chemical Processes: The Use of Molecular Sieves and Microwave Radiation to Enhance Sorption and Recycle</b> W. Connor & Robert Laurence, Dept. of Chemical Engineering	<b>ChemDesign Corp.:</b> Fitchburg, MA	The technology can be used for both in-process recycling of and removal from effluents of volatile organic compounds (VOCs). Applicable across industries including chemicals, graphics, transportation, manufacturing, and electronics.	Chemicals, industrial machinery, petroleum, manufacturing, drugs, textiles, commercial printing, electronics	Air toxics, photochemical smog, climate change, energy demand, wastewater, hazardous waste
<b>Environmentally Benign Products and Processes Based on Homogenous Catalysis</b> Ka Ng, Michael Tsapatsis, Dionisios Vlachos, Phillip Westmoreland & Vincent Rotello, Dept. of Chemical Engineering	<b>Mitsubishi Chemical: Japan Engelhard:</b> IL	Applications for industry suppliers of catalysts (process chemistry) that are used in the manufacture of chemicals, pharmaceuticals, and plastics.	Chemicals, drugs, plastics, petroleum	Air toxics, photochemical smog, acid rain, climate change, energy demand, hazardous waste, wastewater
<b>Catalytic Ozonation for Low-Strength Aqueous Streams</b> David Reckhow, Dept. of Civil and Environmental Engineering	<b>Erving Paper Mills, Inc.:</b> Holyoke, MA	Reduces aqueous waste effluents from paper making and potentially applicable to drinking water treatment to remove chlorinated organic byproducts.	Pulp and paper, municipal water treatment	Water demand, wastewater, disinfection byproducts
<b>Mesoporous Honeycombs: Molecular Sieves for Catalysis and Separations</b> Michael Tsapatsis & Jan van Egmond, Dept. of Chemical Engineering	<b>DuPont Central Research and Development:</b> DE	Applications include: separations for solvent recovery in chemicals, textiles and graphics; in-process separations for improved efficiency in chemicals manufacture; and air separations for improved combustion efficiency and reduced NO <sub>x</sub> formation.	Chemicals, textiles, commercial printing, transportation, energy production	Air toxics, photochemical smog, acid rain, climate change, energy demand, hazardous waste, wastewater
<b>Application of Video Source-Emission Assessment Technology (VSEAT)</b> Salvatore DiNardi, Dept. of Environmental Health Sciences	No partner required: first year program startup	Method for modeling and reducing environmental releases of and worker exposure to hazardous compounds used in industries including chemicals, electronics, dry cleaners, manufacturing, printing, and machine shops.	Chemicals, dry cleaning, textiles, manufacturing, industrial machinery, electronics, printing, pharmaceuticals	Air toxics, photochemical smog
<b>Processing of Recycled-Polyolefin Modified Asphalt to Reduce Consumption and Waste</b> Alan Lesser, Dept. of Polymer Science & Engineering	No partner required: first year program startup	Process simultaneously increases the demand for unsegregated, scrap polyolefins (plastics) while reducing the frequency of road construction and reducing the toxicity of applied asphalt.	Construction, recycling	Municipal solid waste, air toxics
<b>Impurity Extraction from Waste Stream Recyclables/Fractionation Using Supercritical Fluids</b> Alan Lesser & Scott Barton, Dept. of Polymer Science & Engineering	No partner required: first year program startup	Methodology for removing impurities from recycled plastics to increase utilization of recycled material, reducing municipal solid waste burden, while minimizing secondary waste generation.	Plastics, recycling, manufacturing	Municipal solid waste
<b>Pollution Prevention at the Source for Chemical Processes</b> James Douglas, Dept. of Chemical Engineering	No partner required: first year program startup	Methodology for identifying waste minimization problems common to all types of manufactured chemicals industry initially focusing on batch processes and specialty polymers to reduce waste.	Chemicals, petroleum, plastics, drugs, textiles, commercial printing, electronics, manufacturing	Air toxics, photochemical smog, climate change, energy demand, hazardous waste, wastewater

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<b>Simultaneous Reaction-Separation Systems: A New Class of Processes for Eliminating Waste at the Source</b> Michael Malone & Michael Doherty, Dept. of Chemical Engineering	No partner required: first year program startup	Hybrid combination of chemical reaction and distillation, broadly applicable as the basis for innovative process designs to improve yields and productivity and eliminate or reduce by-product formation in the chemicals industry.	Chemicals, petroleum, industrial machinery	Air toxics, photochemical smog, climate change, energy demand, hazardous waste
<b>Process Visualization for Waste Prevention</b> Michael Malone, Dept. of Chemical Engineering	No partner required: first year program startup	Methodology applicable across several industry sectors including chemicals, pharmaceuticals, and electronics.	Chemicals, petroleum, plastics, drugs, textiles, commercial printing, electronics, industrial machinery, manufacturing	Air toxics, photochemical smog, climate change, ozone depletion, energy demand, wastewater