SUMMARY OF TECHNICAL RESEARCH PROJECTS
Funding Year 2002

The University Research in Sustainable Technologies program is a joint project of the Toxics Use Reduction Institute (TURI) and the Center for Environmentally Appropriate Materials (CEAM) at the University of Massachusetts Lowell with support from the Commonwealth's STrategic Envirotechnology Partnership (STEP) program. The University Research in Sustainable Technologies program taps the research capabilities of the University of Massachusetts to advance the investigation, development and evaluation of sustainable technologies that are environmentally, occupationally and economically sound. The program annually provides research funding to UMass faculty from all campuses on a competitive basis, and encourages faculty and industry partnerships as well as cross-campus collaboration.

For FY2002, the program awarded grants totaling $80,000 for research projects at University of Massachusetts campuses at Lowell and Dartmouth. The following is a list of the FY 2002 projects:

Solar Electrolyzer Fuel Cell, 3kW System, Principle Investigator: **John Duffy**, Department of Mechanical Engineering, Solar Engineering Program, University of Massachusetts Lowell. Industry Partner: Electrochem, Inc., Woburn, Massachusetts.

Professor Duffy will receive funding for the second year of research into development of a viable remote area power system using a Proton Exchange Membrane (PEM) fuel cell system capable of delivering 3 kW of electrical energy for up to 24 hours. The fuel cell uses water in a closed-loop system to generate hydrogen via a solar-powered electrolyzer. Specific research concerns will be the design of control systems and proof of concept of the prototype system, focusing on the electrolyzer component of the system.

Insulating Coatings for Electronics, Prepared Using Enzymatic Polymerization of Amphyphilic Alkyl Tyrosine Derivatives, Principle Investigators: **Anastasios Angelopoulos and Kenneth Marx**, Department of Chemistry, University of Massachusetts Lowell. Industry Partner: International Business Machines

Surface coatings are typically required for gold components used in the microelectronics industry, to provide chemical resistance and electrical insulation during subsequent unit processes in the manufacturing operation. Professors Angelopoulos and Marx, in conjunction with their industry partner, IBM, will continue their research into more environmentally benign surface coatings and reaction conditions. Both enzymatic polymerization of certain monomers and electrochemical polymerization from aqueous solution are being performed to create alternatives to the existing coatings and reaction conditions. The result of this year's funding should be development of a process that can be adopted by industry.

Performance Analysis of Lead-Free Printed Wiring Boards, Principle Investigator: **Sammy Shina**, Department of Mechanical Engineering, University of Massachusetts Lowell. Industry

Partners: BTU International, Raytheon, Texas Instruments, M/A-COM, Schneider Automation, and Sanmina.

As the European and global marketplaces consider mandating lead-free electronic equipment, many questions arise about the technical feasibility of replacing lead in printed wiring board soldering applications. The UMass Lead-Free Consortium, a group of companies from across the electronics supply chain led by Professor Shina, will begin Phase II of their testing program this year. The program will test the performance of various lead-free board and component finishes with tin-silver-copper solder materials. Consortium members will contribute materials, board designs and testing services, and the Manufacturing Research Laboratory facilities at UMass Lowell will also be utilized to test and analyze the performance of proposed alternatives.

Innovative Materials for Wire and Cable Coating, Principle Investigator: **Stephen McCarthy**, Department of Plastics Engineering and the Institute for Plastics Innovations University of Massachusetts Lowell.

Professor McCarthy will be investigating materials that do not include toxic materials, such as lead, for use in the wire and cable coating industry. The industry demands materials that meet many stringent performance standards, including those for fire resistance, smoke generation, electrical insulation, and durability. Designing these materials for the environment over their life cycle will mean evaluating additional criteria for materials toxicity, waste generation, recyclability and other environmental, health and safety impacts. This project will explore innovative polymers that could be developed to meeting these varied and demanding requirements.

Natural, "Green" Dyes for the Textile Industry, Principle Investigators: **Sukalyan Sengupta and Bal Ram Singh**, Department of Civil and Environmental Engineering, University of Massachusetts Dartmouth.

Annually, the textile industry produces and uses roughly a million tons of dyes worldwide. The majority of these dyes have typically been synthetically produced. Recently, there has been growing interest in the use of natural dyes, which do not require the use of toxic chemicals in their production, have less impact on energy resources, and generate less harmful byproducts during production. Professors Sengupta and Singh will continue their research into development of plant- and fungal-based dyes for the textile industry as alternatives to synthetic dyes, and the optimization of the production process. This year's research is expected to identify optimum production techniques, and produce enough dye for testing by major textile manufacturers to determine possible commercialization potential