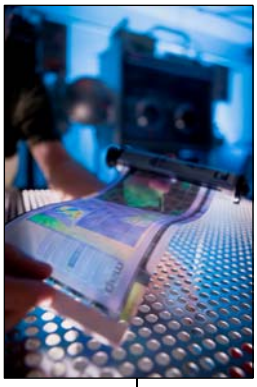
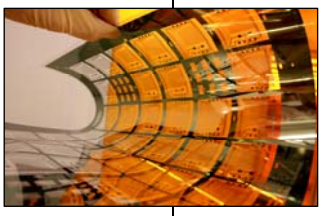
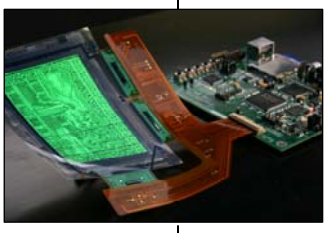
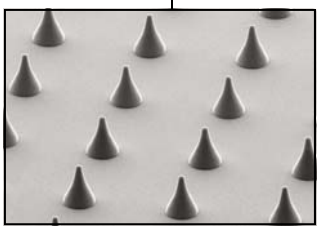
ARIZONA STATE UNIVERSITY TECHNOLOGY AND RESEARCH INITIATIVE FUND (TRIF)

SUMMARY REPORT FOR THE FISCAL YEAR ENDING JUNE 30, 2009









The core competencies of FDC and ANBC demonstrate synergies that are anticipated to make dramatic impacts on the advanced electronics, materials, and workers needed to supply the emerging flexible electronics industry.

Advanced Materials Initiative

The Advanced Materials Initiative (AMI) seeks to expand ASU's research capacity in sensor development, nanotechnology, and the development and characterization of materials of interest to the flexible electronics areas. This initiative builds on ASU's existing strengths in nanoelectronics, sensor development, materials characterization, and emerging strengths in flexible electronics, and nanoscale science and technology. Applications for these technologies include novel microelectronic, microfluidic, and biotechnology devices integrated into microsystems for high-value-added applications in the information technologies, health care, threat detection, transportation, and manufacturing industries. Several industry reports have projected that by 2015 the emerging flexible electronics market could grow to greater than $100B with products such as flexible displays, sensors, energy modules, lighting systems, RF networks, and smart packaging.

AMI combines expertise and capabilities developed at the Flexible Display Center (FDC), and the Applied NanoBioscence Center (ANBC). The FDC was initiated in February 2004 under cooperative agreement W911NF-04-2-0005 by the U.S. Army to create an ASU-led Center that collaborates with government, industry, and other universities to develop solutions for technology development and manufacturing challenges in flexible displays and flexible electronics. FDC has successfully implemented a flexible electronics Pilot Line manufacturing-consistent infrastructure and collaborated on materials and processing tools development to provide supply chain and process development solutions that address flexible substrate system and handling issues.

ANBC specializes in advanced materials and processes for flexible transparent conductors, integrated electronics and energy sources, organic electronics, and system-on-chip technology. In collaboration with universities and industry partners, ANBC is making significant breakthrough developments in converging nanoscience, biotechnology and cognitive science into technology platforms that can be mass produced. To create new ways to diagnose disease, monitor health, and build enabling polymer electronics, new technologies are merged from nanoscience, microelectromechanical systems (MEMS), polymer and ambient intelligence with genomics and molecular biology. This fusion allows for the creation of novel sensor systems with a broad range of commercial applications.

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Dr. Nick Colaneri
Director, Flexible Display Center

PERFORMANCE ANALYSIS

Advanced Materials Initiative PERFORMANCE MEASURES/IMPACT	FY10 Proj	FY11 Proj
Return on Investment ($ amounts in millions)		.
Federal and non-federal awards	31.20	27.60
Royalty income	0.02	0.05
Foundation funding	0.04	0.04
Return Total	31.26	27.69
Work Force Contributions		
Post-doctoral appointments	20	23
Post-doctoral researchers leaving to enter the workforce	10	14
Graduate students employed	7	4
Graduate students earning degrees and entering the workforce	3	4
Undergraduate students involved	4	6
Partnerships/Collaborations		
The number of research grants/contracts involving funding from non-government entities	8	6
The number of research grants/contracts involving subcontracts to non-ASU researchers	3	5

DISCUSSION OF PERFORMANCE

Return on Investment The core funding for AMI is a 10-year cooperative agreement award from the U.S. Army of $93.7M to establish and lead a collaborative partnership to develop flexible, rugged, light-weight, low-power, information displays and electronics for the future war fighter and other military and commercial applications. Industrial members provide an additional $20M million in in-kind and cash contributions over the 10-year agreement. Most of the science for the flexible display initiative has been conducted at the Center; however some related FTA funded projects have allow the FDC to leverage another $10M in funding to support technology development. Other grants include a $3.8 million grant from the Department of Justice to develop a system for the FBI that integrates the current multiple steps of forensic DNA analysis for faster results, an $800,000 grant from the Naval Research Laboratory to develop a lab-on-chip for bioagents, and a $580,000 grant from the Department of Justice to design a microchip for detecting terrorist activity.

Economic Impact The initiative will generate research and clinical partnerships that significantly impact our local economy. According to analysis done by the NIST ATP, $1M in government funding triggers $1.6M industry cost-sharing, causing $8M total economic impact, creating/maintaining about 100 jobs based on an average high tech job average salary of $80K.

Students Trained Full integration of an education and training dimension is positioning the Institute to provide industry with highly capable engineers and scientists skilled in emerging technology development. Educational and workforce development plans include expansion and development of a formal internship program, a devoted student research pilot line tool set, curriculum offerings specific to flexible electronics, an Arizona corporate advisory and sponsorship program and Arizona university and high school student outreach efforts.

Partnerships/Collaborations Partnerships and collaborative relationships serve a critical role in the success of the AMI. The FDC has a proven collaborative partnership model with 27 engaged industry members (33% Arizona-based), 3 university members and strategic alliances with the FlexTech Alliance and the Center for Advanced Microelectronics. ANBC has 12 active partnerships and/ or joint consortium with a wide range of organizations. The Center infrastructure comprises clinical resources with Scottsdale Clinical Research Institute, TGen Clinical Services and other AZ clinical partners. ANBC and TGen co-founded Nanobiomics, that merged with the Molecular Profiling Institute, acquired by Caris Diagnostics. A Center for Interdisciplinary Research in Nanotechnology (CIRN) was developed in partnership with Motorola Labs to develop nanosensors for first responder product applications, and a MIDRA Consortium with Motorola Italy and the University of Florence to develop sensors and wireless communication networks. Strategic alliances with major international consortia in Europe and Asia are being formed.

Collaborative partnerships are in place with the University of Arizona College of Medicine, Banner Health, Barrow Neurological Institute, The Critical Path Institute, Mayo Clinic—Scottsdale, the Translational Genomics Research Institute, the state Medicaid Agency (AHCCCS), and Maricopa Integrated Health Services. These and future partnerships include joint hires, joint research projects, and planned internships and projects for BMI students.

AMI RESEARCH FOCI

The AMI academic-government-industry business model and research-to-manufacturing operational model coupled with unique and synergistic flexible backplane array and biosensor research infrastructure, positions the AMI to be a national leader in the flexible electronics industry. As demonstrated by companies that collocated in the MTW Facility and the recent spin-out companies, AMI has potential to become a business nexus that will differentiate Arizona and provide a competitive advantage for Arizona and AMI collaborators.

The MacroTechnology Works (MTW) Facility, where the FDC and ANBC are collocated, was designed as a organizational mechanism that allows ASU to advance technology in three integrated modalities that are a departure from standard university practice: (1) large scale engagement of industry, (2) integration of design, technology and engineering for product development and (3) rapid applied consumer-driven innovation. This approach bridges the gap between conceptual research and production-ready-product. This model begins with collaboration, conceptualization, design and test, prototype production, regulatory compliance and leads to a product ready for technology transition.

Electronic Design Automation (EDA) for IC Design, Modeling and Simulation: A professional suite of flexible, large area microelectronics design tools has been implemented including: circuit simulation, design rule checking (DRC), layer verification (LVS), layout, AutoPlace and Route with *Standard Cell Library Development Capability,* state-of-the-art a-Si:H transistor models including VT Shift, and an extensive suite of digital and analog circuit testing equipment. Recently, a circuit simulator that can predict the complex post-degradation response of arbitrary a-Si:H TFT circuits was developed. Also, a standard cell library for a-Si:H TFTs on flexible stainless steel and plastic substrates was developed. The standard cell library enables layout automation with a standard cell place and route tool, significantly reducing the time to layout a-Si:H digital circuits on the backplane and thus enhancing functionality.

Flexible Electronics Pilot Line Fabrication: Pilot Line tool sets are linked to a Manufacturing Execution System (MES) for efficient lot management and statistical process control (SPC) and include the following:

- 6-Inch (150 mm) Wafer-scale Pilot Line for Research and Development (3 micron feature size (L/S))
- GEN II (370 mm x 470 mm) Pilot Line for Low Volume Production (3 micron feature size (L/S))

Capabilities also include characterization tools/processes and plans are in place to pursue printed electronics capabilities and pilot-line level organic light emitting diode (OLED) integration.

Integrated Electronics for Advanced Functionality: This research is focused on: integrated nano/micro-systems design, modeling, and prototyping; development of fabrication and characterization techniques optimized for nanoscale applications; molecular techniques for manipulating single biomolecules and cells; and integrated systems for application-oriented products and information solutions. Considerable proficiency has been demonstrated in: biochips for genomics/proteomics; microfluidics and microanalytical technology; nanoconstrictions; atomic and molecular technology; nanosystems design and fabrication; microscale fluid dynamics modeling; and hybrid nanoelectronics processing and "lab-fab" prototyping. Skills have been developed for bioassay development and polymer-based processing. Plans include improving: micro/nano fabrication processes, materials biocompatibility, assays, and integration and functionalities. Improved processable materials, flexible transparent conductors, integrated electronics and energy sources, organic electronics, and system-on-chip technology are also in work.

Technology Demonstrators and Technology Transition: In order to increase a user demand for the technology it is critical to demonstrate its application in a real world scenario. Considerable capability exists to develop hardware to demonstrate newly developed technologies. AzTE is a resource that is used to facilitateted the transition process.

FINANCIALS

Advanced Materials Initiative	FY10 Rev Budget	FY11 Rev Budget
REVENUE		
Carry Forward		
New TRIF Revenue	400,000	400,000
TOTAL REVENUE	**$400,000**	**$400,000**
OPERATING BUDGET		
Personal Services	163,200	163,200
Employee Related Expenses	38,400	38,400
Operating Expenses	118,400	118,400
Total Operating Budget	$320,000	$320,000
CAPITAL BUDGET		
Building Renovation	80,000	80,000
Debt Service		
Total Capital Budget	80,000	80,000
TOTAL EXPENDITURES	**$400,000**	**$400,000**
Return On Investment	**78.1:1**	**69.2:1**

Goals & Results

Goals:

- Develop a robust research engine to strategically address emerging flexible electronics opportunities and to accelerate technology transition opportunities.
- Position Arizona as a leader in the flexible microelectronics industry and promote Arizona businesses that will in turn build on the Arizona economy, provide more and higher paid knowledge-based jobs and help attract new business investments.
- Apply advances in nanoscience, molecular biology and genomics to a new generation of enabling tools converging nano- and micro-scale technologies to better understand the molecular origin of diseases.
- Employ best scientific and engineering practices to help fundamentally change the approach to improving global public health, by developing and facilitating the use of molecular diagnostic tests.
- Advance personalized medicine by fostering transformation of biological and physical principles into effective products with focused impact on oncology, orphan rare diseases and infectious diseases

Results and Updates: Several technology platforms have been scaled up and commercialization is ongoing.

- Contributed to tool and materials development and commercialization needed for flexible electronics manufacturing: DuPont Teijin Films' Planarized PEN substrate material, EV Group's large-area thin film spray coater, and Honeywell's thermally stable family of planarization, electrical isolation, and passivation materials.
- Generated IP for non-volatile a-Si memory, flexible substrate systems, low-temperature transistor processing onto flexible substrates and temporary bonding procedures to allow standard semiconductor processing of flexible substrates. Discussions are in progress with 6 companies for transition of this IP to commercial use.
- FDC flexible displays highlighted by WIRED Magazine as a Top 10 technology breakthrough for 2008.
- Jointly developed DNA solutions with FBI and leaders in DNA forensics which is being validated as an international standard for deployment in casework investigations.
- Developed specialized molecular medical responses for acute medical management of radiation injury in cancer treatment or radiologic and nuclear events.
- Submitted the ANBC blood-based gene expression assay and instrumentation to the FDA.
- Optimized novel bioassay chemistries in collaboration with diagnostics corporations and federal agencies for molecular diagnostics of cardiovascular diseases, colon and melanoma
- Obtained contracts for developing "green' high-density energy systems using biofuels and fuel cells (FC).

Management

Office for the Vice President for Research and Economic affairs

R.F. "Rick" Shangraw: Vice President for Research and Economic Affairs

Sethuraman "Panch" Panchanathan: Deputy Vice President for Research

Advisory Board

- **David C. Morton —** Flexible Display and Electronics Manager, Army Research Laboratory, Sensors and Electron Devices Directorate
- **Keith Rollins —** Global Displays Market Manager, DuPont Teijin Films (UK) Ltd.
- **Abbie Gregg —** Owner, Abbie Gregg Inc.
- **Steve Dwyer —** VP and General Manager, EV Group, North American Headquarters
- **Mike Idacavage —** Principal Research Fellow, Cytec Industries, Inc.

Building Locations

AMI is located in the MacroTechnology Works Building in the ASU Research Park in Tempe.

Learn More

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ASU
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