IOWA STATE UNIVERSITY

BATTELLE UPDATE: JANUARY 01, 2009 – JUNE 30, 2009

<table>
<thead>
<tr>
<th>Platform</th>
<th>Expenditures</th>
<th>Total Allocation</th>
<th>Project Allocation</th>
<th>Project Obligated</th>
<th>Infrastructure Allocation</th>
<th>Infrastructure Obligation</th>
</tr>
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<tbody>
<tr>
<td>Advanced Food &amp; Feed</td>
<td>$166,830.88</td>
<td>$856,334</td>
<td>$507,572</td>
<td>$348,762</td>
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<td>Advanced Manufacturing</td>
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<td>$1,054,666</td>
<td>$-</td>
<td>$1,273,530</td>
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<td>Biosecurity</td>
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<td>$793,470</td>
<td>$450,000</td>
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<td>Total</td>
<td>$-</td>
<td>$6,410,000</td>
<td>$3,690,000</td>
<td>$348,762</td>
<td>$2,720,000</td>
<td>$-</td>
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</tbody>
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BATTELLE FUNDING: PROGRESS REPORT

Purpose: Endowed Chairs
Purpose Funding: $2,000,000
Purpose Expenditures: $2,000,000

Progress Report:
The fund raising for the four endowed chairs is complete. All chairs have been established/named. The status of each chair follows:

1) The previously reported W. Eugene Lloyd Chair in Toxicology in the College of Veterinary Medicine has been awarded to Dr. Peter Nara. Dr. Peter Nara is currently co-founder, president and CEO of Biological Mimetics, Inc., a Maryland-based company that commercializes pharmaceutical products. Nara is also a former section chief of the Vaccine Resistant Diseases section at the National Cancer Institute, U.S. National Institutes of Health, in Washington, D.C.

2) In July 2008, the College of Veterinary Medicine received a $1 million pledge from a donor who has requested anonymity to establish the Anderson Chair in Veterinary Medicine. Dr. Jesse Goff has been hired for this position. Dr. Goff is an entrepreneur with involvement in two Ames start-up companies.

3) In December 2007, $500,000 was committed to match a $1 million gift from the estate of Charles Schafer to establish the Charles Schafer Chair in Biorenewable Energy Science and Technology in the College of Engineering. Unfortunately, the negotiations were not successful with the identified candidate and we are pursuing other options.

4) The fourth Battelle chair has been established as the Kriby Gray Chair in Engineering. The first identified candidate did not accept the position and we are pursuing other options.
**PROJECT 1 (Rothschild)**

**Publications/presentations based on project:**


**External funding applied for (indicate received/denied/pending):**

| Association of genetic markers with structural soundness and sow longevity (M Rothschild, K Stalder) | National Pork Board | $86,000 |
| Association of genetic markers with structural soundness and sow longevity year 2 (M Rothschild, K Stalder) | National Pork Board | $118,669 |

**$100,000 received National Pork Board** Large scale SNP association analyses of feed efficiency and longevity

**Progress Report (300 word maximum):**

This grant uses the pig as an animal model to predict bone disorder predisposition in pigs and humans. In this work, 214 genes affecting skeletal development and mineral metabolism were chosen and a total 435 SNPs were detected in 146 genes and these SNPs were deposited to dbSNP of NCBI (Accession numbers: ss86352080-ss86352515). Five Sequenom’s genotyping multiplexes were developed involving 172 SNPs. We excluded SNPs with no calls, monomorphism, mistaken inheritance, MAF less than 5% and a call rate less than 85%, 119 SNPs from 95 genes were successfully genotyped for 2066 commercial pigs which were scored for 17 traits describing various leg and feet and conformation conditions. Association analyses between SNPs and individual scoring traits, and principal components (PCs) were completed using SAS package. A number of genes were found to be significantly associated with the various leg traits. Planning of *in vitro* functional studies on bone marrow culture system is being conducted for important genes.

A second grant was received from the National Pork Board to do much larger scale association work, called whole genome association analyses. To do this, the Illumina Porcine Bead Chip with over 50,000 SNPs is being used. Genotypes were taken on a total of 800 animals and the analyses of these are now underway. SNP quality appears to be good and we are reviewing genotypes. It is hoped this will help point to gene pathways affecting bone health in pigs and humans. Analyses will be conducted to examine associations. Funding for the project has now been completed.

Platform leader Rothschild has met with new groups concerning expanded commercial activities in Iowa and two companies are starting up.

**PROJECT 2 (Ellinwood)**

**Publications/presentations based on use of infrastructure:**

- Presented at the 10th International Symposium on Mucopolysaccharide and Related Diseases: Intrathecal and Intravenous rhIDU treatment of MPS I dogs from birth
- A recombinant N-acetyl-alpha-D-glucosaminidase (Naglu)-Apolipoprotein E ligand domain fusion: Paradoxically similar cellular internalization properties to native Naglu
- Delivery of a recombinant Naglu fusion enzyme to the central nervous system after a systemic AAV2-8 vector injection in the MPS I IIIB mouse model
- Presented at the 4th International Conference: Advances in canine and feline genomics and inherited diseases
- Canine Facto VII deficiency: Propagation of inadvertent inherited genetic diseases within canine research breeding colonies.
- Atypical transitory congenital hypothyroidism in a feline colony


• Karen L. Kline. Preliminary Clinical Neurologic, Cardiac, Ophthalmologic and MRI Findings in Mucopolysaccharidosis Type IIIB (MPS IIIB) Dogs. American College of Veterinary Internal Medicine, 25th Annual Meeting, Seattle Washington, June 6-10.

Invention disclosures utilizing infrastructure purchases:A provisional patent application filed April 23, 2008, with the US Patent and Trademark Office (PHOSPHORYLATED RECOMBINANT N-ACETYL-alpha-D-GLUCOSAMINIDASE (NaGlu) AND USES THEREOF)

External funding applied for utilizing infrastructure purchases (indicate received/denied/pending):

<table>
<thead>
<tr>
<th>Description</th>
<th>PI/PIA</th>
<th>Funding for Fiscal Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institut Pasteur, Paris, France</td>
<td></td>
<td>$66,420</td>
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<tr>
<td>Intrathecal Enzyme Therapy For Mucopolysaccharidosis I</td>
<td>P.I. Dickson</td>
<td>2006-2001</td>
</tr>
<tr>
<td>NIH, National Institute of Neurology and Stroke, as a subcontract (R01 HL085107)</td>
<td>PI of Subcontract from Harbor-UCLA Medical School</td>
<td>$621,139 (Total Sub)</td>
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<td>Treatment of Leukocyte Adhesion Deficiency By Foamy Virus Vectors</td>
<td>D. Russell</td>
<td>2006-2008</td>
</tr>
<tr>
<td>NIH, National Institute Heart Lung and Blood, as a subcontract (R01 HL085107)</td>
<td>PI of Subcontract from University of Washington Medical School</td>
<td>$50,000 (Total Sub)</td>
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<td>Evaluation of Multiple Intrathecal Administrations of rhIDUA to MPS I Affected Cats</td>
<td>N. Matthew Ellinwood</td>
<td>2006-2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$21,680</td>
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</tbody>
</table>
BioMarin Pharmaceuticals

Support For Research On MPS N. Matthew Ellinwood PI 2006-2007 140,000
IIIB and IIIC

Sanfilippo Children’s Research Foundation
Pathogenesis of Murine MPS N. Matthew Ellinwood PI 2007-2008 $25,000
IIIB

Lysosomal Storage Disorder

Research Consortium

**Progress Report (350 word maximum):**

Work supported aims to develop biomedical research in 1) neurologic and 2) ophthalmologic diseases which capitalize on ISU strengths in large animal biomedical models. Substantial progress was made at the research or grantsmanship level. A review of specific goals follows:

Neurologic Conditions Achievements

1. Develop an enzyme fusion capable of crossing the blood brain barrier. Work continues on this project which has yeiled a patent application for the recombinant fusion protein which will likely generate interest from specific biopharmaceutical company for the production of a therapeutic product to treat MPS IIIB.

2. Further characterize and maintain a feline congenital glaucoma model. This model continues to be maintained and used to characterize this spontaneous and unique model for one of the worlds leading causes of blindness. This model is the subject of an awarded grant to Dr Gill McLellan, Univ of WI.

In conclusion, this award has helped in the securing of ~$1,000,000 in direct competitive external grant funds. Additionally over 10 abstracts, invited presentations, and peer reviewed publications were generated. Finally one patent disclosure is proceeding, associated with work done as part of this platform grant.

**PROJECT 3 (Greenlee)**

**Progress Report (350 word maximum):**

Dr. Molly Murphy, the post-doc supported by these funds is continuing to collect data as the majority of animals that are intended for this study are at the National Animal Disease Center (a collaborator on this project) have been and are still at pre-clinical stages of disease.

We have begun to analyze some of the data gathered in the preclinical period. In addition, the first animals have begun to show some signs of disease, and we have begun tissue collection.

Data collected by Dr. Murphy will be used as preliminary data in a proposal to be submitted to NIH (Characterizing retinal pathology associated with transmissible spongiform encephalopathies). Target submission date has gain been delayed (now target is February 2010), as will need to include some data from clinically affected animals.

**PROJECT 4 (Spurlock)**

**NO REPORT RECEIVED**

**INFRASTRUCTURE (Ellinwood)**

Publications/presentations based on use of infrastructure:
Presented at the 10th International Symposium on Mucopolysaccharide and Related Diseases: Intrathecal and Intravenous rhIDU treatment of MPS I dogs from birth

A recombinant N-acetyl-alpha-D-glucosaminidase (Naglu)-Apolipoprotein E ligand domain fusion: Paradoxically similar cellular internalization properties to native Naglu

Delivery of a recombinant Naglu fusion enzyme to the central nervous system after a systemic AAV2-8 vector injection in the MPS I IIIB mouse model

Presented at the 4th International Conference: Advances in canine and feline genomics and inherited diseases

Canine Facto VII deficiency: Propagation of inadvertent inherited genetic diseases within canine research breeding colonies.

Atypical transitory congenital hypothyroidism in a feline colony


Invention disclosures utilizing infrastructure purchases:
A provisional patent application filed April 23, 2008, with the US Patent and Trademark Office (PHOSPHORYLATED RECOMBINANT N-ACETYL-alpha-D-GLUCOSAMINIDASE (NaGlu) AND USES THEREOF)

External funding applied for utilizing infrastructure purchases (indicate received/denied/pending):
The National MPS Society, “Development of Pharmacoperon Based Therapy fro the Treatment of MPS IIIIB”, Letter of intent invited for full application. $60,000. Application denied.

CIAG - $8000

Progress Report (300 word maximum):
This infrastructure award was used to renovate large animals research/housing facilities in Kildee Hall. These facilities and the animals housed therein have been instrumental in securing over ~1,000,000 in extramural funding, one patent application, and over 10 publications, abstracts, or presentations since this award was made.

STARTUP FUNDS

Title: Genetics of Dairy Cattle – Start-up Funds
Principle Investigator(s): Diane Moody Spurlock

Publications/presentations based on use of infrastructure:


Awards received related to infrastructure purchases:
Grad student competitive research paper presentation, 3rd place awarded to Ms. Dawn Elkins, M.S. student division

External funding applied for utilizing infrastructure purchases (indicate received/denied/pending):

- Genetic regulation and genomic selection of energy balance traits in dairy cattle. Received. USDA-NRI, March 1, 2008 – February 28, 2011. $446,972
- Data collection at the ISU Dairy. Submitted to Merial. Pending, $135,000

Progress Report (350 word maximum):
Funds have been used to establish a research program studying the genetic and physiological regulation of energy balance in dairy cattle. This program currently has two primary focus areas. (1) Genetic regulation and genomic selection of energy balance traits in dairy cattle. USDA-NRI funding has been awarded to evaluate genotypes from a panel of 50,000 of bovine single nucleotide polymorphisms (SNP) and determine associations with multiple traits relating to energy balance in lactating dairy cows. This is a collaborative project with the Scottish Agricultural Center (SAC). To date, genotypes have been determined for 300 animals representing the SAC population, and phenotypic data are currently being collected cows at the ISU Dairy. This project will evaluate genotypes and phenotypes from a total of 800 cows. (2) Integrated regulation of lipolysis by perilipin, adipose triglyceride lipase, and CGI-58 in dairy cows. We are studying the physiological regulation of energy balance by investigating novel proteins involved in regulating the mobilization of energy substrates from adipose tissue in lactating dairy cows. We have determined that the abundance of phosphorylated perilipin is correlated with indicators of lipolysis, and that the abundance of adipose triglyceride lipase is greater in cows in mid lactation compared to early lactation. Our continued investigation of these proteins will expand our understanding of the regulation of energy mobilization in response to negative energy balance in dairy cows. To date, this research has resulted in the presentation of two abstracts and a manuscript (in press), and is supported by funding from USDA-NRI.

BATTELLE FUNDING: PROGRESS REPORT

Update Period: January 01, 2009 – June 30, 2009
Title: Advanced Food & Feed: Advanced Carbohydrates for Health
Platform: Advanced Food and Feed
Platform Expenditures: $166,830.88
Platform Co-Chairs: Ruth MacDonald
Platform Funding: $856,334*
  Project Allocated: $507,572
  Project Obligated: $348,762**
  Inf. Allocated: $ -
  Inf. Obligated: $ -

*In addition to the Battelle funds, $330,000 from ISU’s FY07GIVF funding was used to support research projects associated with this platform.

** This funding is reserved as a start-up package for the Director of the Nutrition & Wellness Research Center (to be hired)
PROJECT 1 – NWRC

Progress Report:
These funds were provided for salary support for staff of the Nutrition and Wellness Research Center. The funds have been used for that purpose. The NWRC is now staffed with a research project coordinator, an accountant, an office coordinator and a communications manager. In addition student workers are employed to assist with research projects. The search for a Director has begun and there is expectation that the Director will be in place within the next year.

PROJECT 2 (MacDonald)

Project Goal: To determine the role of dietary carbohydrates in reducing the symptoms of inflammatory bowel disease.

Progress report (300 word maximum):
Completed work includes three animal studies to examine the effects of dietary components on colon inflammatory responses. In this work, we have used a chemical induction model to mimic human inflammatory bowel disease in mice. Several dietary interventions were performed to characterize a protective response. We have analyzed colon samples from these experiments for cytokine expression using the Luminex system which provides 23 cytokine quantifications. From these data, we observed many were increased by the induction of inflammation and dietary intervention prevented the increase in a few. In the colon samples we have also quantified histological changes and COX-2 and B-catenin using Western immunoblot. The analysis of these parameters is ongoing. In current work, we are preparing to analyze the samples for TLR-4 and NFkB which are mediators of the inflammatory response. We have met with Dr. Eric Weaver from Proliant on several occasions throughout the work and sought his advice and input on the studies. In addition, a graduate student Huyani Jiang, has joined the project and her work is to develop the TLR-4 assay. From these studies we are gaining a better understanding of how dietary factors can impact the inflammatory response associated with inflammatory bowel disease with the goal of finding ways to reduce the systems of this disease in the human population.

STARTUP FUNDS (Spurlock)

NO REPORT RECEIVED

BATTELLE FUNDING: PROGRESS REPORT

Update Period: January 01, 2009 – June 30, 2009
Title: Thermochemical Technologies for the Bioeconomy
Platform: BioEconomy
Platform Chair: Robert Brown
Platform Expenditures: $1,734,027.38
Platform Funding: $2,164,666
  Project Allocated: $1,054,666
  Project Obligated: $ -
  Inf. Allocated: $1,273,530
  Inf. Obligated: $ -

NOTE: The following report is a combined platform/infrastructure report.

Publications/presentations based on use of infrastructure:


• Two presentations at the American Oil Chemists’ Society. One on the separation of saturated esters from high-oleic soybean oil converted to butyl or iso-propyl esters. One on the products of the surface oxidation of methyl linoleate spread as a monolayer on silica gel.

**Invention disclosures utilizing infrastructure purchases:**

IPDR entitled "Ethanol production by combined fermentation and chemical synthesis." was filed with ISURF.

**External funding applied for utilizing infrastructure purchases (indicate received/denied/pending):**

- Funding received: Conoco-Philips, $150,000 (3/07-12/07)
- Funding received: Conoco-Phillips and ADM $200,000 (1/08-12/08)
- Funding received: Annotation of novel enzymatic functions in methanogens : Amount: $1.25M
  - Funding Agency: DOE-GTL : Dates: October, 2007-October, 2010
- Funding pending: CPBR
- Funding Received: Department of Energy under award number: DE-FG36-07Go87003.
- Funding Received: Project Title: Fast Pyrolysis Process Development Unit for Validating Bench Scale Data
  - Duration: October 2007- September 30, 2008
  - Amount of funds awarded by DOE: $500,000
  - Cost share from ISU: $125, 132
- Funding received: Catalytic Upgrading of Bio-Oil, ConocoPhillips, $162,974 (5/07-12/08)
- Funding Received: Condensed Phase Catalysis with Bio-Oil Species, ConocoPhillips, $70,000 (1/08-12/08)
- Title of project: Engineering Research Center on Biorenewable Chemicals
  - Funding Agency: National Science Foundation
  - Date submitted: December, 2007
  - Status: Pending
- Department of Energy under award number: DE-FG36-07Go87003.
  - Project Title: Fast Pyrolysis Process Development Unit for Validating Bench Scale Data
  - PI: Robert C. Brown
  - Status: received
  - Duration: October 2007- September 30, 2008
  - Amount of funds awarded by DOE: $500,000
  - Cost share from ISU: $125, 132
RESEARCH PROJECTS

Task 1: Thermochemical Products: Syngas production and clean-up

Task Objective:
The objective of this task is to produce syngas with properties suitable for catalytic or biocatalytic upgrading to fuels and bioproducts.

Summary of Progress to Date:
A ThermoStar mass spectrometer was purchased from Pfeiffer Vacuum and installed to analyze producer/syngas contamination levels. The mass spectrometer instrument was calibrated with the following matrix of gases for quantitative analysis: Hydrogen Sulfide, Hydrogen Chloride, Ammonia, Sulfur Dioxide, Methane, Carbon Dioxide, Carbon Monoxide, Hydrogen, Nitrogen, Ethylene, and Ethane. This matrix...
contains the primary constituents of the producer/syngas gas stream after the water and organic tars were removed.

Equipment purchases and upgrades to the gasifier using Battelle funding allowed for work to be completed during the last reporting period to understand the relationship between biomass alkali concentrations and carbon conversion during the gasification process. Results of said work will be published in a graduate student thesis later this summer and submitted to a peer reviewed journal.

Task 2. Thermochemical Products: Enhancing gas-liquid mass transfer

Progress Report (300 word maximum):
The biologically mediated water-gas shift reaction using *R. rubrum* was enhanced by the introduction of MCM41 nanoparticles with or without functional mercaptopropyl groups. These results complement previous studies and suggest that the increased H₂ yield was due to enhanced CO-water mass transfer.

Task 3: Syngas fermentation pilot facility

Progress Report (300 word maximum):
Experiments this year have completed our studies to optimize growth and fermentation condition for *Rhodopirillum rubrum* for hydrogen and polyhydroxyalkanoate (PHA) during growth on syngas. Limiting nitrogen concentrations in the growth media was shown to increase the yield of PHA by approximately 400% with no effect on hydrogen production.

Task 4: Thermochemical Products: Ethanol production by combined fermentation and chemical synthesis

Progress Report (350 word maximum):
The goal of this task is to examine an alternative route to ethanol production that avoids the high energy and water costs of distillation. We previously engineered *E. coli* to produce acetaldehyde plus hydrogen. These compounds can be converted to ethanol bypassing distillation. During this reporting period we continued work on increasing the yield of acetaldehyde and hydrogen which are currently produced at about 500 μM and 84 μM, respectively.

Task 5 - Thermochemical Products: Establish functional genomics of *Rhodopirillum rubrum* metabolism

Progress Report (300 word maximum):
This task has focused on understanding and manipulating the metabolism of *Rhodopirillum rubrum* so as to make this organism more suitable as a platform for the fermentation-based conversion of syngas to biorenewable chemicals and biofuels.

Since the last report, we have completed the characterization of the negative gene effectors that modulate the ability of this organism to produce biorenewable bioplastics. To address this question we created *R. rubrum* strains that lack functional negative genes individually or in combination. Genes that have been evaluated include: *phaC*, *phaC-like1*, *phaC-like2*, and *phaJ*, the double mutant combinations of *phaC* and *phaC-like1*, *phaC and phaC-like2*, *phaC-like1* and *phaC-like2*, and the triple mutant in which all three genes *phaC*, *phaC-like1*, and *phaC-like2*. These characterizations led to the discovery of specific genes and gene combinations that can be manipulated to enhance bioplastics production.

Task 6 - Thermochemical Products: Developing stable bio-ols from fast pyrolysis
Summary of Progress to Date:
Work on task 6 focuses on generating bio-oil under well characterized operating conditions in conjunction with the characterization of the physicochemical properties which influence bio-oil stability.

The original goal of building a new pyrolysis unit has been expanded with the receipt of $500,000 from the U.S. DOE which allowed us to purchase new feedstock preparation equipment as well as design and build more sophisticated bio-oil collection equipment. The new fast pyrolysis reactor, char removal system, and bio-oil collection equipment have been designed, built, and installed. The system is being used to support newly sponsored research with the Department of Energy and the ConocoPhillips Company to explore methods to improve bio-oil stability.

In an ongoing effort to improve our ability to characterize biomass and bio-oil, instrumentation capabilities continue to be added to the analytical laboratory. Two recently purchased instruments include a HPLC (from Dionex) for quantifying the bio-oil major chemical compositions and a TGA/DSC (from Mettler) for determining biomass, bio-oil and biochar proximate analysis.

Task 7: Oleochemicals: Identifying physical and chemical attributes for improved biobased lubricants and fuels

**Progress Report (300 word maximum):**
Silica gel was treated with trivalent vanadium, and a monolayer of methyl linoleate was spread on the silica and oxidized. The vanadium produced an induction period because it converted the hydroperoxides to epoxides. Vanadium increased the percentage of epoxides obtained significantly and may be useful as a lipid antioxidant.

Task 8: Bio-Oil Upgrading

**Progress Report (350 word maximum):**
In addition to ongoing work on bio-oil upgrading through esterification, C-C coupling, and steam reforming, which is now funded by ConocoPhillips and the Department of Energy, we are performing scouting experiments on bio-oil model compounds using aqueous-phase reforming. This work is the basis for the National Science Foundation proposal.

**STARTUP FUNDS**

**Title:** Raman Startup Funds

**Publications/presentations based on use of infrastructure:**


**Progress Report:**
Battelle Funds provided to Associate Professor D Raj Raman as startup funds were used to support the following activities:

- Summer salary to allow working on multiple biorenewable related projects, including low-cost pretreatment reactors using aqueous ammonia steeping method, and organizing Intensive Program in Biorenewables using Cargill Gift funds to bring over 40 students from across the country and around the world to ISU campus to learn about biorenewables.
- Summer salary allowed authoring a paper entitled Mathematical Models of Batch SSF Processes: Dimensionless Groups for Characterizing Process Regime, which defines a novel method of characterizing SSF (simultaneous saccharification and fermentation) that can be used by scientists developing high-throughput fermentation screening methods for lignocellulosic biomass.
- Funds were used to develop a conceptual framework for comparing various biomass feedstocks. This framework was expanded as part of the A E 480/580 course that Dr Raman taught, and led to a $50k award from the Biorenewable Industry Consortium this past May. This work is being prepared for publication.

Title: Grewell Startup Funds

Publications/presentations based on use of infrastructure:

Progress Report (350 word maximum):
This work has a patent pending application and focuses on embossing features designed to act as reservoirs, valves, and reaction chambers to allow glucose and lactate levels to be measured in solution using a standard PC-CD player and thus termed ‘Glucose/lactate Bio-CD’. Once embossed, the surface energy of the plastic substrate was chemically modified to make it hydrophilic by increasing the surface energy by approximately 135%. Flash-free micro patterns were embossed on thermoplastic substrates. The embossing technique relies on a micro-cellular foamed substrate to absorb the displaced material during the embossing process so that flash is not produced (zero mass transfer in near fields). It was demonstrated that a CD utilizing a photoluminescence (PL) could characterize glucose and lactate levels, using an organic light-emitting diode (OLED) as the excitation source. Enzyme samples were placed in reservoirs and directed through burst valves, by rotation of the CD, toward a reaction chamber, where the analytes were oxidized in the presence of oxygen and their specific oxidase enzymes. The analytes’ concentrations were determined by monitoring the PL decay time of an oxygen-sensitive dye following a pulsed OLED excitation. The results demonstrate the viability of the PP CD for sensing applications in conjunction with an OLED-based sensing platform. The potential of integrating OLED arrays as excitation sources in PL-based sensors with the microfluidic CD-based platform, including for simultaneous multiple analyses is discussed.

Title: Koziel Startup funds
NO REPORT RECEIVED

INFRASTRUCTURE FUNDS PROVIDED TO COLLEGES

College of Engineering
NO REPORT RECEIVED – PREVIOUS REPORT
Dr. Chris Williams has upgraded a servo-pneumatic testing machine for testing materials associated with bio-energy research. Research will be under contract within the next 6-12 months. A substantial amount of exposure is being received by the research team associated with utilizing bio-energy co-products in asphalt materials and this equipment will further expand their research capabilities and thus research exposure.
Dr. Terry Meyer purchased components for building a quadruple pulse laser system that will help develop technologies for alternative fuel processing and utilization.

Dr. Santosh Pandey has purchased a Leica Microscope with High-resolution Digital Camera & Vibration Isolation Table. This equipment will be used for testing characteristics of living cells and microorganisms under various stimuli. The electrically-active bio-nanoelectronic platform combines the versatility of nanoscale circuits with the flexibility of polymeric substrates to study biological processes. Our portable assay would allow label-free detection of a specific biological specimen and nanoscale probing of its characteristics. The electronic detection scheme would provide real-time information over a long time interval, which is not possible with optical or fluorescence-based assays. Combined with high-performance computing features and embedded systems, the microscope system can provide real-time monitoring of biological processes.

He also purchased a two-section glove box from MBraun Inc. for research in organic and bio-electronics of material which are sensitive to air and humidity.

Dr. Jaeyoun Kim purchased an optical table, its support, and a pneumatic controller. The heavy, very flat optical table stabilized by pneumatic floating will serve as the platform in various high-precision optical experiments. He will purchase lasers, optomechanical stages, and detectors. The equipment will be essential for the development of high-performance optical sensing, communication, and computing systems including surface plasmon resonance sensors and nanoscale optical waveguides.

**College of Liberal Arts and Sciences**

**Emily Smith (Startup package)**

**Publications/presentations based on use of infrastructure:**

- “General Fluorescence Resonance Energy Transfer Assay for the Study of Cell Membrane Protein Clustering” 34th Federation of Analytical Chemistry and Spectroscopy Societies, Memphis, TN, October 2007.

**Awards received related to infrastructure purchases:**

Society of Analytical Chemists of Pittsburgh Starter Award (2007)

**External funding applied for utilizing infrastructure purchases (indicate received/denied/pending):**

- Society of Analytical Chemists of Pittsburgh 2007 Starter Grant Award, “Development of Raman and Fluorescence Imaging Methods for the Study of Cellular Processes and Biological Materials in Diverse Applications” 5/1/07-4/30/08, $20,000

**Pending Support**

- NSF CAREER, “Development of Novel Methods to Measure Cell Membrane Protein Clustering in vivo: Unraveling the Relationship between Clustering, Ligand Binding and Cell Signaling” 2009-2014, $798,068
Progress Report (300 word maximum):
We are developing imaging instrumentation and methods, and subsequently applying these techniques in a diverse set of applications, including the study of cellular processes that are initiated at the cell membrane, lignocellulosic biomass, and catalytic systems. Two goals of this work are elucidating how properties of the cell membrane influence cell signaling events across the membrane, and developing methods to study reactions utilizing chemical and biological catalysts. The analysis techniques that we use include fluorescence and Raman scattering. Raman imaging is a particularly attractive imaging mode since it provides spatially-correlated chemical content data without the need to destroy or modify the sample under study. Fluorescence imaging can provide kinetic and thermodynamic information concerning biological interactions, and can also provide spatial data below the diffraction limit. The lab has built two imaging instruments, one capable of Raman scattering measurements and one suitable for several fluorescence techniques. The Raman instrument has been used to measure the efficiency of converting a variety of plant materials to ethanol, and to measure chemical catalysis in nanoporous materials. This work serves as a foundation for developing biofuels and improving the efficiency of catalytic reactions. The fluorescence instrument has been used to study cell membrane receptor signaling.
College of Agriculture
Construction of the biomass processing facility at the New BioCentury Research Farm is nearing completion and the initial equipment installations will be made in the coming months. The grand opening scheduled for September, 2009.

BATTELLE FUNDING: PROGRESS REPORT

Update Period: July 01, 2006 – December 31, 2006
Platform: BioSecurity
Platform Chair): Manjit Misra
Platform Expenditures: $609,195.34
Platform Funding: $793,470
Project Allocated: $450,000
Project Obligated: $ -
Inf. Allocated: $ 343,470
Inf. Obligated: $ -

PROJECT FUNDS:

Publications/presentations based on use of infrastructure:

- Aubrey Mendonca (Co-PI): Functional Food Ingredients and Related Compounds as Antimicrobial Enhancers for Improving the Safety of Fresh Produce. USDA. $370,058. Pending.

External funding applied for utilizing infrastructure purchases (indicate received/denied/pending):

Funded

- Mendonca, A, and A. L. Pometto III. 2007. Antimicrobial Efficacy of a Novel Antimicrobial Skin Cleanser against Foodborne Enteric Pathogens on a Model Skin Surface. IPRT ($12,057) and Northern Filtration Media ($12,065)

Pending

Progress Report (350 word maximum):
DDGS (Distiller Dried Grains with Solubles) and CDS (Condensed Distiller’s Solubles or “Syrup”) were obtained from Lincoln Way Energy, Nevada, IA. Extracts (25% w/v) of DDGS were prepared by steaming for 2 hrs @88°C in water or 20% (v/v) ethanol. The liquid portions of the extracts were recovered by vacuum filtration through Whatman #1 filter paper, concentrated to syrups by rotary evaporation at 60°C, then adjusted to pH 7. Ethanol lost during the evaporation step was replaced to a final concentration of 20% (v/v). Extracts were filter sterilized through 0.2 µm filters, then tested for anti-microbial activity against *Esherichia coli* O157:H7, *Listeria monocytogenes*, *Salmonella*, sp., and *Staphylococcus aureus*. Tests were done on the Bioscreen Growth Curve instrument in replicates of five.

*S. aureus* and *L. monocytogenes* were not inhibited by the extracts. It is likely that nutrients in the extracts stimulate these bacteria, resulting in improved growth. With *E. coli O157:H7*, slight inhibition was observed with aqueous extracts; inhibition was greater in ethanolic extracts. *Salmonella*, sp. was moderately inhibited by aqueous- and ethanolic extracts. Viability tests showed that the DDGS extracts did not kill the cells, so their effects are bacteriostatic, not bacteriocidal. CDS (syrup) was also tested with similar results. With *E. coli*, only slight inhibition was observed, and then only with the highest doses of CDS. With *S. aureus* and *L. monocytogenes*, low doses of CDS produced slight inhibition; however, when the dose was doubled, growth was stimulated. Like DDGS extracts, CDS may contain nutrients that improve the growth of these organisms. *Salmonella*, sp. was more sensitive to CDS than the other bacteria.

Dr. Scott Hurd continues to work with GlobalVetLink on the on-line traceability of food animals. Prior work has focused on beef cattle. While that work continues, the project is now expanding to include swine.

INFRASTRUCTURE FUNDS

Equipment Purchased/Renovations Made:
All equipment has been purchased and installed. Final inspections are being done and we anticipate everything will work fine. Installed equipment includes two bioguard hoods, a solvent hood and an anaerobic chamber equipped with a BioScreen C MBR reader to study anaerobes and microaerophiles.

Progress Report (300 word maximum):
William Colonna continues to supervise the work of the Discovery Lab. Recent work has included testing of extracts of DDGS (Distiller Dried Grains with Solubles) and CDS (Condensed Distiller’s Solubles or “Syrup”) obtained from Lincoln Way Energy, Nevada, IA in September 2008. It was observed that *Salmonella*, sp. was inhibited by extracts. Therefore, the mechanism of inhibition of *Salmonella*, sp. by CDS was examined in greater detail. Although the inhibition was potentiated at acidic pHis, it was observed at neutral pH, demonstrating that the inhibition was not a simple effect
of pH. Moreover, the extent of inhibition was not affected by inoculum size. Instead, the degree of inhibition and inhibition profile were identical if the inoculum size (i.e., CFU/mL) was reduced by 10- to 100-fold.

Viability tests showed that exposure to CDS does not kill the bacteria, demonstrating that the inhibition is bacteriostatic, not bacteriocidal. Also, with all bacteria, there was essentially no difference in the extent of inhibition by CDS that was sterilized by filtration or by autoclaving. The heat-stability suggests that the inhibitory substance in CDS is of low molecular weight.

STARTUP FUNDS

Title: Munkvold startup funds

Publications/presentations:

- Colonization of maize roots by Fusarium spp. in relation to transgenic corn rootworm resistance G. Munkvold, L. Münke, L. Lewis and A. Fessehaie

Progress Report (350 word maximum):

Larvae of the corn rootworm (CRW) (Diabrotica spp.) injure maize roots through their feeding activity, completely destroying some roots and leaving others with extensive epidermal and cortical damage. We hypothesized that the roots of plants with CRW injury will be more intensively colonized by soilborne fungi, including root and stalk rot pathogens. In 2007 and 2008, we planted maize hybrids in fields where high populations of CRW had been encouraged through the use of trap crops. Hybrids genetically engineered with different genes for CRW resistance were compared to their near-isogenic CRW-susceptible counterparts in replicated plots in each of three locations (Mead, NE; Ames, IA; Crawfordsville, IA, USA) in 2007 and two locations (Mead and Crawfordsville) in 2008. We measured CRW injury (0-3 nodal injury scale) and Fusarium colonization (by dilution plating and quantitative PCR) in mid to late July and again in mid September, and recorded the incidence of stalk rot symptoms in plants collected randomly from each plot. CRW injury was severe on susceptible hybrids, especially at the Mead location in 2007 and Crawfordsville in 2008, with scores averaging ~2.0. Transgenic hybrids showed moderate to high levels of resistance, with average scores <1.0. Several Fusarium species were isolated from roots, including F. verticillioides, F. proliferatum, F. semitectum, and F. graminearum. Dilution plating showed that colonization by all Fusarium species was higher in CRW-susceptible hybrids exceeded that of their CRW-resistance counterparts for locations with severe CRW feeding injury, although results for individual plants were highly variable. Several of the observed Fusarium species are stalk rot pathogens and CRW-susceptible hybrids also had more severe symptoms of stalk rot than resistant hybrids. However, quantitative PCR results from roots and stalks did not demonstrate consistent differences in colonization by F. verticillioides and F. graminearum between CRW-susceptible and CRW-resistant hybrids. These results indicate that root colonization by Fusarium species in the presence of CRW is suppressed by CRW resistance, but the effect is dependent on the species of Fusarium; furthermore, stalk quality is improved in CRW-resistant hybrids under these conditions, but the difference could not consistently be attributed to F. graminearum or F. verticillioides.

INFRASTRUCTURE ALLOCATED TO COLLEGES

College of Agriculture
Funding was approved for construction of a field building erected in FY07. The building is being used primarily by a new tenure-track faculty member for field research on soybean pathogens.

College of Vet Med
A small allocation has been made to the College of Vet Med to assist in building the BL3 facility. Construction should occur within the next year.
**BATTELLE FUNDING: PROGRESS REPORT**

**Update Period:** July 01, 2006 – December 31, 2006  
**Title:** Information Solutions  
**Platform Chair:** Jim Oliver  
**Platform Expenditures:** $771,903.69  
**Platform Funding:** $1,718,000  
**Project Allocated:** $650,000  
**Project Obligated:** -  
**Inf. Allocated:** $1,068,800  
**Inf. Obligated:** -

**PROJECT FUNDS**

External funding applied for (indicate received/denied/pending):

- “Center for Information Protection: NSF IU/CRC Industry Memberships,” Doug Jacobson, PI, $150,000. awarded
- “EFRI: Development, Validation, and Use of Sense of “Self” in Robots,” Alex Stoytchev, PI, with Co-PI’s Nicola Elia, Akhilesh Tyagi, Umesh Vaidya, James Bloedel, and Srikanta Tirthapura, $1,948,294, National Science Foundation, pending.
- “A Distributed Peer to Peer Investigation Tool Kit,” Doug Jacobson, PI, $558,110, National Institute of Justice, pending.
- “Center for Information Protection: NSF IU/CRC Industry Memberships,” National Science Foundation, $60,000, Doug Jacobson
- CyberInnovation Institute Industry Memberships, Deere & Company, $50,000.00, January 1, 2008 to December 31, 2008, James Oliver
- “NETS-NBD: Network Coding-Based Protection,” National Science Foundation, $103,700, Ahmed Kamal, PI, with Co-PI Aditya Ramamoorthy, pending

**Progress Report (350 word maximum):**

To help foster the cross-disciplinary research needed to address today’s complex challenges, CII announced openings for five postdoctoral positions. These full-time, two-year post-docs will work with faculty teams to address research in one or more of the following areas:

- High-performance computing
- Data Mining, information integration, semantic web
The post-docs will work closely with faculty and students on cross-disciplinary research projects to develop the advanced cyberinfrastructure and new research opportunities in bioinformatics, materials informatics, security informatics, and computational fluid dynamics (among others). The CII post-docs are expected to begin as early as August 15, 2008.

Last reporting period, CII announced a joint industry/university project funded by the Grow Iowa Values Fund entitled: “Multi-Touch Technology: Applications to Homeland Security and ISU Research.” This spring, the CII helped the PI’s negotiate an agreement with ISU’s Office of Intellectual Property and Technology Transfer to enable the results of the project to be distributed via open source. The resulting library “Sparsh” facilitates the creation of multi-touch applications on a variety of hardware and software platforms. Details can be found at: http://code.google.com/p/sparsh-ui/

On April 3-4, the CII co-sponsored the second annual “Emerging Technologies Conference” (ETC 2008) in Ames. This conference features the research progress of CII member centers, with particular emphasis on the Virtual Reality Applications Center and its graduate program in Human Computer Interaction. ETC2008 kicked off on the evening of April 3 with “IgniteIT” a networking opportunity for Iowa’s information technology community to spark imaginations, connect people, create new technology opportunities in Iowa and have fun in the process. More than 200 regional IT professionals attended IgniteIT, which was hosted at the CII Technical Collaboration Facility in ISU’s Research Park. On Friday April 4th, ETC2008’s was anchored by a keynote address entitled “HCI: Help Create Ideas—Exploring Innovation Leadership” presented by Michael Schrage, an affiliate of MIT’s Sloan School, widely published columnist, consultant for the United States government, and author of two critically acclaimed books focused on the social implications of technology. ETC2008 was open to the public and its technology demonstrations attracted over 300 attendees.

INFRASTRUCTURE FUNDS

Awards received related to infrastructure purchases:

- “NSF I/UCRC Center for Information Protection-Deere,” Doug Jacobson, DEERE AND COMPANY, $15,000, Information Assurance Center - CII, 1/13/2009
- “CAREER: Practical Scheme Design for Supporting Secure and Resilient Resource-Constrained Wireless Networks” Yong Guan, NATIONAL SCIENCE FOUNDATION, $12,000 Information Infrastructure Institute – CII, 4/16/2009
- “Creating an Information Dashboard to Explore Market Data for Enhanced Portfolio Creation and Management,” Kenneth Bryden, DEERE AND COMPANY, $80,000, Virtual Reality Applications Center, 2/4/2009
- “A Virtual Reality Interface for Product/Analysis Data Visualization,” James Oliver, ROCKWELL COLLINES, INC, $140,000, VRAC 6/24/09
- “Virtual Reality Implementation Study,” James Oliver, BOEING COMPANY, $50,000, Virtual Reality Applications Center, 4/25/2009

External funding applied for utilizing infrastructure purchases (indicate received/denied/pending):

- “Sequence and Structural Correlates of Protein-RNA Interactions,” Drena Dobbs, NATIONAL INSTITUTES OF HEALTH, $1,459,331, Center for Computational Intelligence, Learning, and Discovery – CII, 2/4/2009, pending
- “REU Supplement: Collaborative Research: Learning Classifiers from Autonomous, Semantically Heterogeneous, Distributed Data,” Vasant Honavar, NATIONAL SCIENCE FOUNDATION, $16,000 Center for Computational Intelligence, Learning, and Discovery – CII, 4/30/2009, pending
- “Gene Networks as Biomarkers for Stem Cells Useful to Treat Retinal Degeneration,” Mary Greenlee, NATIONAL INSTITUTES OF HEALTH, $999,997, Center for Computational Intelligence, Learning, and Discovery – CII, 4/24/2009, pending
- “Computational Methods for B-Cell Epitope Identification,” Vasant Honavar, NATIONAL INSTITUTES OF HEALTH, $669,190, Center for Computational Intelligence, Learning, and Discovery – CII, 4/22/2009, pending
- “Expanding Technological Literacy Through Engineering Minors,” Mani Mina, NATIONAL SCIENCE FOUNDATION, $500,000, Information Infrastructure Institute – CII, 1/12/2009, pending
- “ARO Workshop on Digital Forensics,” Yong Guan, ARMY RESEARCH OFFICE, $30,000, Information Infrastructure Institute – CII, 2/23/2009, pending
- “UFit: A Ubiquitous Fitness Promotion System Based on Innovative Wireless and Social Networking,” Daji Qiao, UNIVERSITY OF MEMPHIS, $250,000, Information Infrastructure Institute – CII, 4/14/2009, pending
- “Collaborative Research: CSR-PSCE, SM: Memory Thermal Management for Multi-Core Systems,” Zhao Zhang, NATIONAL SCIENCE FOUNDATION, $12,000, Information Infrastructure Institute – CII, 4/29/2009, pending
- “CT-ER: Detecting Click Fraud in Pay-Per-Click Streams of Online Advertising Network,” Yong Guan, NATIONAL SCIENCE FOUNDATION, $12,000, Information Infrastructure Institute – CII, 4/16/2009, pending
- “Center on Interfacial Engineering for Microelectromechanical Systems,” Krishna Rajan, STANFORD UNIVERSITY, $1,012,500, Institute for Combinatorial Discovery – CII, 6/19/2009, pending
- “Combining 3D Scanning and Imaging,” Song Zhang, WASHINGTON UNIVERSITY, $132,529, Virtual Reality Applications Center, 3/10/2009, pending
- “Graduate Student Research Program,” Eliot Winer, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, $30,000, Virtual Reality Applications Center, 1/29/2009, pending
- “Collaborative Research: Constraint-Based Compliant Mechanism Design Using Virtual Reality as a Design Interface,” Judy Vance, NATIONAL SCIENCE FOUNDATION, $12,000, Virtual Reality Applications Center, 5/12/2009, pending

Progress Report (300 word maximum, include how the infrastructure has been utilized):

By encouraging partnerships, CII nurtures new synergies among faculty, students, industry leaders, and entrepreneurs to create an entrepreneurial culture that fosters connections and opportunities. This vision motivated the creation of a space that encourages collaboration and community. To date, five companies have located at the CyberInnovation Technical Collaboration Facility, building on CII’s commitment to economic development in the state of Iowa. Our industry partners now include:

- Entrepreneurial teams:
  - New entrepreneurial clients since January include:
    - Measure Inc., a design company focused on new media communications.
    - 3Fueled, an Iowa start-up focused on storage and transportation logistics for bio-fuels.
  - Complimenting our existing entrepreneurial clients:
    - Adapt Data Solutions, online issues tracking software (http://www.adaptdds.com/)
    - ProPlanner, a developer of web-based simulation tools for manufacturing automation
    - Intuition Games, a new computer game company
    - Mack Enterprises, a video and sound editing company
    - Visual Medical Solutions LLC, a company that is developing technology for medical personnel to easily visualize and interact with 3-dimensional images of patients’ complex internal systems, helping them plan and prepare for specific operations.
  - Start-ups terminating their agreements with CII (both due to closure of business)
    - ClearSighted, which designs and develops intelligent tutoring systems software to change the ways that future computer-based learning is done.
    - Kung Pow Studios, a custom animation company.

- Members:
  - Unfortunately, our only industry member, Deere and Company elected to not renew its CII membership in January 2009, citing the difficult economic climate. However, since Fall 2008 we have formalized CII’s Industry Research Membership Program (IRMP) with official By-Laws and streamlined the contracting processes. In addition we have commitment from ISU’s Industry Relations team to help re-market the membership program during 2009-2010, and are confident that, with the improving economic outlook, it will be successful.

These partnerships build on CII’s commitment to economic development in the state of Iowa. Start-up companies share resources (from the copy machine to student interns) and network access with other startups as well as bigger IT companies. Overall these resources ease the start-up process by providing a space to collaborate on the challenges in commercializing new technologies.
As an educational, training, and research resource, the CII Technical Collaboration Facility also houses the Information Assurance Center's (IAC) Internet Scale Event and Attack Generation Environment (ISEAGE). IAC personnel work with regional high schools and local industry leaders to sponsor programs to engage high school and undergraduate students in IT. IAC also sponsors training short courses for industry, both at CII, and remotely, with a mobile system.

Current ISEAGE projects include:

- MapIowa, a graphical simulation of the Iowa Communications Network that can be dynamically attacked, crippled, or modified to research the effects of a catastrophic failure of the network;
- ISECUBE, a portable ISEAGE that can be used to create a virtual copy of a network for testing. The first remote information security industry workshop was held in Omaha in June using an ISECUBE;
- National and local Cyber Defense Competitions; and
- IT Adventures, a program to motivate high school students to pursue a career in IT.

For more information about the new and ongoing activity at CII, visit our web site: www.cyberi.iastate.edu.

INFRASTRUCTURE PROVIDED TO COLLEGES

College of Liberal Arts and Sciences
Publications/presentations based on use of infrastructure:

Publications:


Presentations: (new for this period)

External funding applied for utilizing infrastructure purchases (indicate received/denied/pending): Only new projects or updated information within the update period are listed here.

**Received:**
- Co-PI on “A Multi-scale Approach to Addressing Bio-Remediation”, DOE ($1,500,000)

**Pending:**
- Co-PI on “Computational Evolution of Aptamer Specificity”, NIH ($1,761,745)
- Co-PI on “CDI-Type II: Dynamics and Kinetics for the Rational Design of Protected Functional Nanoparticles”, NSF ($1,838,243)
- Co-PI on “DUE CCLI Phase II: Vertical Integration of Chemical Bonding in the Undergraduate Curriculum”, NSF ($499,987)
- Co-PI on “PRAC: Computational Chemistry at the Petascale”, NSF, ($31,800)
- Co-PI on “Improving Developer Productivity for HPC through Cyberinfrastructure: Applications, Languages, Tools and Services”, NSF ($1,950,000)

**Denied:**
- Co-PI on “PRAC: Computational Chemistry at the Petascale”, NSF ($31,800 + 620 Million CPU hours)

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**Equipment Purchased/Renovations Made:**

Purchase of 105 4GBx2 memory upgrades.

**Progress Report (300 word maximum):**

In one major research effort, we have been using dynamic nucleation theory Monte Carlo to examine small water clusters, small nitric acid clusters and small sulfuric acid clusters using ab initio methods – their reaction rates, energy distributions and properties. In our quest to reduce the number of quantum mechanical evaluations, we have continued developed of a method to scale configurational probability distributions obtained at high temperatures to lower temperatures without any additional evaluations. These results are currently being reviewed for an article in the Journal of Physical Chemistry A. In addition, we have had two papers accepted on the overall methodology and parallel algorithms used in the research.

In addition, we have continued to make significant inroads into the computational science of component development. On the component front, we have been tackling the complex issue of developing components for interoperability of integral codes between three computational chemistry codes, NWChem, GAMESS and MPQC. While the final testing is still in progress, the interfaces have been defined and the interfaces have been implemented. We have also continued to develop new components for combined quantum and molecular mechanics computations. These components have been tested with the NWChem framework and a paper has been submitted.

In collaboration with George Kraus, an experimentalist at ISU, we have been performing calculations on the selective metalation of 4,6-dibromoresorcinol dimethyl ether. The calculations are successful in predicting the products produced from the several reactions of interest and in explaining the steric buttressing effect of the methyl groups. This work is in the final preparation stages for submission to the Journal of Organic Chemistry.
Finally, we have started extremely accurate computations of oxygen atom with ethylene to study the dynamics of the nonadiabatic crossings on the reactive surfaces. These calculations will represent the most accurate computations of these surfaces and will lead to new insights on the actual mechanisms of the crossings.

**College of Engineering:**
Previously reported

- **Principle Investigator:** Aaron Clapp

**Publications/presentations based on project:**

**External funding applied for (indicate received/denied/pending):**
- $31,000 for Equipment for Aaron Clapp, CBE Department
- Denied: Ames Lab seed grant, NIH R01
- Pending/future: NIH R21, NSF CAREER

**Equipment Purchased/Renovations Made:** On PO I7-50307-00, purchased Fluoromax-4; Research spectrofluorometer with 150w ozone free Xe source and power supply. Also, on PO I7-49358-00, used $6,653 of the Battelle funding towards the purchase of a unilab antechamber.

**Progress Report (300 word maximum):**

These funds were used as part of a startup package where the equipment has been in place for approximately 1.5 years.

The Fluoromax-4 is a highly sensitive fluorescence fluorometer which we use to formally characterize fluorescent nanoparticles synthesized in our laboratory. It is a workhorse piece of equipment and invaluable to our research. Recently, it has been used to study protein-protein interactions using fluorescence resonance energy transfer (FRET) where quantum dots donate energy to nearby fluorescent dyes. The emission spectrum provides quantitative distance and orientation information about the associating biomolecules. This is a capability that is greatly enhanced through the use of this instrument.

The mini antechamber is an integral part of the Unilab glovebox system which allows us to safely handle air-sensitive precursor materials such as diethyl zinc. The antechamber is absolutely necessary for transferring materials into and out of the glovebox system. We use the glovebox daily in our work.

- **Principal Investigator(s):** Jim Alleman

**External funding applied for utilizing infrastructure purchases (indicate received/denied/pending):**

This equipment has provided all faculty the opportunity to benefit from this donation. In FY08, 128 proposals were submitted and 82 funded for a total of $9,056,980 for CCEE/CTRE staff.
Equipment Purchased/Renovations Made:

Dual Core Intel Xeon 5050 Server for the CCEE Department. New server provides the capability of larger memory storage and real-time computer access for an entire research group.

Progress Report (300 word maximum):

1) Five professors within the department (more than 20% of our total faculty) are using the system for archival and backup data storage as well as for routine IT applications tied to individual research and departmental operations. In addition, our department’s staff communications specialist also uses the system primarily for large-scale photo and video archiving and retrieval (i.e., see item #4 below).

2) One of these professors (i.e., Charles Jahren) is in charge of the CCEE department’s ‘distance education’ (DE) initiative, and according uses the server as the department’s DE-related course file storage repository. A related highlight point on this account is that our department’s DE activities represent one of the most rapidly evolving college-level DE operations, with rapidly expanding course offering and enrollment changes, and the use of this server plays a strategically critical role with local hosting of course materials.

3) Yet another professor using this system (i.e., David White), uses the server for high-level storage of data tied to his world-class initiative in geo-construction engineering. In this case, Dr. White is also studying the parallel use of this server as a repository for real-time data acquisition via on-site sensors tied to intelligent construction technologies coupled with in-field geotechnical equipment.

4) This server is also used as the primary storage site for all departmental photographs and videos taken during routine student, faculty, and staff events. This information is then used for both developing both print and web-based materials.

- Principal Investigator(s): Jaeyoun Kim

Publications/presentations based on use of infrastructure:


External funding applied for utilizing infrastructure purchases (indicate received/denied/pending):

An Implantable Optical Glucose Sensor (to NSF, pending)

Equipment Purchased/Renovations Made:

- WS-400B_6NPP-Lite Processor Singer Wafer Spin with vacuum pump and SPIN2000-PC interface software from Laurel Technologies ($5,390)
- FEMTO 40KHZ Plasma System including Leybold D1.5B Vacuum Pump, Food Grade Vacuum hose from Diener Electronic ($11,185)
- ST-UT2-46_8 Table Assy, Support System, and ACMP-02 Compressor Assy from Newport Corp ($8,45672)
- Leica Microscope with Camera and Vibration Isolation Table from north Central Instruments (Paid $4,071.75, $20,267.85, and $4,243.50)
- GB-08 Labmaster 130 (2500/1000) with single purification and analyzer from M Braun Inc ($31,416.90)
Progress Report (300 word maximum):
The research focuses on a novel plasmonic waveguide structure for future applications in photonic integrated systems. Plasmon waveguides are attractive for their ability to confine electromagnetic waves on subwavelength scale, which is not possible in purely optical waveguides. Numerous plasmonic waveguiding structures have been demonstrated. Many of them require, however, extremely small feature size or high aspect ratio which makes their implementation prohibitively difficult. We invented a new plasmonic waveguiding structure called “quasi-coplanar plasmon waveguide (QCPW).”

The results of 2D numerical studies reveal that QCPW has many desirable characteristics: (1) The fabrication QCPW involves only standard lithographic and deposition processes. (2) It supports a wide range of wavelength, especially the important “telecommunication bandwidth”. (3) The size of propagating modes is far below wavelength scale. (4) The tolerance of the modal characteristics to the fabrication imperfection is good. These 2D results are published and presented [2,4].

Since the QCPW structure is partially open in lateral directions, its performance in “perturbed 3D operations”, such as propagation through waveguide bends or couplers, needs to be confirmed with 3D simulations. The results show that: (1) 2D mode analysis and 3D propagation simulation results match well each other. (2) The coupling between QCPW becomes negligible when the waveguides are separated by more than 500 nm, (3) The bending loss becomes negligible when the bend radius becomes greater than 8 microns. (4) The QCPW supports a new type of mode called the half-mode. It is useful for implementing plasmonic interferometers. (5) By covering part of the QCPW structure with metal films, we can increase the transmission through an ultracompact waveguide bends by a factor of 2. These results are published and presented in 2008 [1,3].

In the 2nd half of 2008, we will seek the mechanism for bending efficiency improvement.

A two-section glove box from MBraun Inc. for research in organic and bioelectronics of material, have also been purchased, which are sensitive to air and humidity.

The Barrett WAM is a state of the art robot arm with 7 degrees of freedom in the arm and an additional 7 degrees of freedom in the hand. It is highly dexterous and has human-like grace and dexterity. Two WAM arms were purchased and they will be used to construct an upper-torso humanoid robot. The robot will be used to conduct cutting edge research in autonomous and developmental robotics.

Previous information:
- Andrew Hillier. $120,000 is currently encumbered on this fund. It is match support for the Keck Grant. Dr. Andy Hillier has placed a purchase order to AJA International, Inc. for an ATC Series Combinatorial/Conventional Sputtering System. The W. M. Keck Foundation established the W. M. Keck Laboratory for High Throughput Atom-Scale Analysis to drive the frontiers of combinatorial science and atom-scale materials research. This lab provides sample preparation and characterization facilities in support of the research activities performed by members of the Institute for Combinatorial Discovery as well as researchers throughout Iowa State University and the public. The laboratory provides unique materials preparation and characterization facilities that support a range of research and educational projects.
- Dr. James Alleman purchased a Dual Core Intel Xeon 5050 Server for the Civil Construction and Environmental Engineering Department. The new server provides the capability of larger memory storage and real-time computer access for the entire research group.
- Dr. Song-Chang Kong purchased time on the Lighting Cluster (high performance computing). This computer time will allow him to perform combustion process modeling which is vital to his effort to find better ways to burn bio-renewable fuels in engines cleanly, efficiently and effectively. If we want to increase use of bio-renewable fuels to lessen our dependence on petroleum based engine fuels, this kind of research must occur.
- Dr. Krishna Rajan spent $81,000 of the Battelle funds to purchase a Nano Test Platform and NTX Controller with High Temperature option and High temperature extension. The equipment was purchased from Micro Materials Limited. The total cost of the equipment was $188,905. The benefits of the equipment are various
including the ability to collaborate with several other faculty members at ISU and support industrial sponsored projects in the areas of mechanics of materials and high temperature behavior of materials.

- Dr. Richard LeSar spent $80,000 of the Battelle funds to purchase a portion of the large computer system. This equipment is essential for Dr. LeSar's work on computational materials science, providing the ability to model a wide range of materials behavior. Results of this work enable the ability to collaborate with other ISU researchers and to develop strong and active ties with industry and governmental research efforts.

**BATTELLE FUNDING: PROGRESS REPORT**

**Update Period:** July 01, 2006 – December 31, 2006  
**Title:**  
**Platform:** Advanced Manufacturing  
**Platform Chair:** Ron Cox  
**Platform Expenditures:** $ -  
**Platform Funding:** $100,000  
  - **Project Allocated:** $100,000  
  - **Project Obligated:** $ -  
**Inf. Allocated:** $ -  
**Inf. Obligated:** $ -  

**Progress Report:**  
The work is scheduled to be completed in FY10.