



Center for Nanoscale Science and Technology

Office of the Director
2104 Micro and Nanotechnology Laboratory
208 North Wright Street
Urbana, IL 61801
www.cnst.illinois.edu

November 12, 2009

Re: Invitation to: NSF I/UCRC Second Planning Illinois-Purdue Joint Workshop on Dec. 4, 2009 at Purdue University, West Lafayette, IN

Dear Industry Colleague:

We are pleased to inform you that, as a result of your support, we were awarded a planning grant by the U.S. National Science Foundation to initiate the Center for Agricultural and Pharmaceutical Nanotechnology (CAPN). As financial support from Industry will be used to fund the Center, we enthusiastically welcome your input to drive the Center research agenda. Our next task is to identify specific areas of interest that support your research goals, and to simultaneously enhance the nation's competitive workforce through formation of long-term research partnerships.

We recently held our first planning workshop at the University of Illinois at Urbana-Champaign on August 31-Sept. 1, 2009. More than 14 industry representatives participated. An outcome of the workshop was the development of a preliminary list of projects of interest to the participating industry representatives (see appendix). To provide industry with an additional chance to add to the project list, we would like to **invite you and colleagues to attend our Second Planning Workshop on December 4, 2009 at Purdue University, West Lafayette, IN**. We have planned presentations from Illinois and Purdue faculty, industry, federal agencies, and open discussion.

By the end of the meeting, we will have a working document that will define the path of our industry-driven research agenda. Your participation will result in high quality research projects, in-depth interactions with faculty, and mentorship of students who are knowledgeable in industry research. The Center will actively encourage direct involvement of industry representatives in research projects. Particularly during the current uncertain economic environment, we are confident that this model of industrial-academic partnership will enable you to leverage a small research investment to access a wide breadth of world-class faculty, state-of-the-art facilities, and highly relevant research projects. A draft agenda is attached for your information.





We invite you to attend this important meeting and contribute to the discussion. Please confirm participation by sending an email to Dr. Irfan Ahmad at isahmad@illinois.edu, and by registering online at: <http://online.engineering.illinois.edu/nanotech/>

Sincerely,

Prof. Brian T. Cunningham, co-PI, Illinois

Prof. Richard Linton, co-PI, Purdue

Dr. Irfan Ahmad, co-PI/Project Coordinator/Industry Liaison

Encl:asa

 **Center for Agricultural and Pharmaceutical Nanotechnology (CAPN)** 

Contact Information
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Irfan Ahmad, Industry Liaison
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www.cnst.illinois.edu/capn.htm 



Preliminary List of Industry Interest Projects at Workshop I-Illinois

1. Nanoparticle Encapsulation for Drug Delivery to Food Animals (Elanco – Tiffany Houchin)
2. Targeted Pesticide Delivery (Dow Agrosciences – Paul Borth)
3. Nanoparticle Impurity Scavengers (Dow Agrosciences)
4. Insect Pheromone Detection System (Dow Agrosciences)
5. Water Quality Monitoring Sensor (Honeywell – Dinkar Maylaraswami)
6. Low Power Sensors for Autonomous Systems (Honeywell)
7. Biosensors for Mass Markets (Intel– Madoo Varma)
8. Thermoplastic Starch-Based Films (National Starch – John Leighton)
9. Bacterial Detection (National Starch); (Kraft Foods – Michael O’Brien)
10. TBA (Baxter– Jane Fisher)
11. Methods for Product Identity Preservation (USDA– Hongda Chen)
12. Increasing Nutrient Bioavailability (Kraft– Michael O’Brien)
13. Use Nanotechnology to Convert Carbohydrates into Ethanol without Harsh Chemicals: Probiotic and prebiotics, Determine fate of compounds in GI tract

Questions for Industry Visitors to Consider in Advance of CAPN Planning Workshop

1. What pre-competitive basic research needs can be addressed by CAPN faculty that would provide fresh insights or innovative concepts for new product development, quality control, or manufacturing methods?
2. What specific projects can be undertaken with CAPN laboratory resources that are not available within your own company?
3. Would an engineer or scientist from your company be willing to participate in a CAPN project as a mentor or collaborator?
4. What collaborations can you envision with other CAPN industry partners?
5. What is your highest research priority?





Center for Agricultural and Pharmaceutical Nanotechnology (CAPN)
NSF Industry/University Cooperative Research Center
Initial Planning Workshop Aug. 31-Sept. 1, 2009

Co-sponsored by:

[University of Illinois Center for Nanoscale Science and Technology](#)
[Colleges of Engineering, and Agriculture](#)

University of Illinois at Urbana-Champaign
[Micro and Nanotechnology Laboratory](#) (MNLT)
www.cnst.illinois/capn.htm

Industry Participants: First Planning Workshop

The CAPN planning meeting is an industry-driven workshop, the following companies and start-ups have registered or indicated interest to attend.

There are four sets of companies, these include:

- Agricultural and Biotechnology
- Nanotechnology and Chip Manufacturers
- Pharmaceutical
- Systems Integrators

1. Advanced Bioimaging Systems, LLC
2. Archer Daniels Midland
3. Baxter
4. Carle Clinic
5. Caterpillar
6. Dow Agro Services
7. Elanco Animal Health
8. Fonterra (USA), Inc.
9. Intel
10. Honeywell
11. John Deere
12. Kraft Foods, Inc.
13. Monsanto
14. National Pasteurized Eggs, Inc.
15. National Starch, LLC
16. Pilotaseptic
17. PROVE IT, LLC
18. Rich Products
19. Rockwell Automation
20. TRACE Photonics, Inc.

For more information contact

Brian T. Cunningham, co-PI
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Irfan S. Ahmad
Project Coordinator/Industry Liaison
isahmad@illinois.edu

Sponsors:

University of Illinois Center for Nanoscale
Science and Technology
Colleges of Engineering and Agriculture at
Illinois





Federal Agencies

- Food and Drug Administration
- United States Department of Agriculture

**not attending*

Consortiums

- Chicago Museum of Science and Industry*
- Illinois Coalition for Science and Technology
- Illinois Soybean Association*
- Nanobusiness Alliance*

To attend please register online at: www.cnst.illinois.edu/capn.htm

For more information email:

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Sponsors:

University of Illinois Center for Nanoscale Science and Technology
Colleges of Engineering and Agriculture at Illinois

Other co-sponsors include:

NCI-funded Siteman Center for Cancer Nanotechnology Excellence (SCCNE), Illinois
USAID-HEC-Pakistan-funded Nanomedicine for Cancer Research Project, Illinois
Micro and Nanotechnology Laboratory, Illinois
Nano-CEMMS, Illinois
NCN/NanoHub, Illinois-Purdue
Birck Nanotechnology Center, Purdue
Bindley Bioscience Center, Purdue
Center for Food Safety Engineering, Purdue





**Center for Agricultural and
Pharmaceutical Nanotechnology (CAPN)
NSF Industry/University Cooperative Research Center**

www.cnst.illinois.edu/capn.htm

**Center for Agricultural and Pharmaceutical Nanotechnology (CAPN)
NSF Industry/University Cooperative Research Center
Second Planning Workshop:
December 4, 2009**

Venue:

Discovery Park
Burton D. Morgan Center, Room 121
1201 West State Street
Purdue University
West Lafayette, IN 47907

Draft Program

Friday, December 4, 2009

7:45 am	Participant Registration
7:45 – 8:15 am	COFFEE, BAGELS, AND SOCIAL TIME
8:15 – 9:00 am	Welcoming remarks Tim Sands, Director Birck Nanotechnology Center Dr. Marshall Martin, Assistant Dean, College of Agriculture Dean/Assoc Dean of Pharmacy, Purdue (to be confirmed) Dr. Michael Bragg, Executive Associate Dean for Academic Affairs, College of Engineering, Illinois (to be confirmed) Dr. Jozef Kokini, Associate Dean of Research, College of Agricultural, Consumer, and Environmental Sciences, Illinois Dr. Rashid Bashir, Director, Micro and Nanotechnology Laboratory, Illinois Sally Gutierrez, Director, ORD, National Risk Management Research Lab., EPA (to be confirmed) Jeff Morris, National Nanotechnology Program Manager, EPA (to be confirmed)





Sean Liu, Biotechnology Labs., USDA, Peoria, IL (to be reconfirmed)

Wendy Sanhai, Office of the Commissioner, FDA (via remote link) (to be confirmed)

9:00 – 9:30 am Vision and Capabilities of the Center
Prof. Brian T. Cunningham, University of Illinois (UIUC)
Prof. Richard Linton, Purdue University

9:30 – 10:30 am **Project Presentations – NANOTECHNOLOGY**

Joe Irudayaraj, Purdue
Nanoscale Platforms for Detection of Pathogens and Analytes

Kaustubh Bhalerao, Illinois
Synthetic Biology: Opportunities at the Nano-Bio Interface

Cagri Savran, Purdue
Diffraction-based Chemical and Biological Sensors

Logan Liu, Illinois
VLSI Nanophotonic Peptide Sensor Array for Ultrasensitive Pesticide Sensing and Molecular Drug Screening

Brian Cunningham, Illinois
Photonic Crystal Fluorescence Enhancement for High Sensitivity DNA and Protein Detection

10:30 – 10:45 am **BREAK**

10:45 – 11:45 am **Project Presentations - PHARMACEUTICAL**

Kinam Park, Purdue
Nanofabrication Using Hydrogel Templates

Steve Sligar, Illinois
Lipid Bilayer Nanodiscs for Drug Discovery and Therapeutic Delivery

Paul Hergenrother, Illinois
The Use of Photonic Crystal Biosensors to Identify Inhibitors of Protein-DNA and Protein-Protein Interactions

Jo Davisson, Purdue
Biomolecular Labeling and Quantification Employing SERS

Suranjan Panigrahi
FLASS (First Line of Alert Sensor System): A complementary sensing System approach for





food safety and disease diagnosis

11:45 am – 12:30 pm **Project Presentations – AGRICULTURE**

Arun Bhunia, Purdue
Biosensor Technologies for Foodborne Pathogens and Toxins

Rashid Bashir, Illinois
Microfluidic Bbiochips for Label Free Detection of Biomolecules and Cells

Bruce Applegate, Purdue
Microbial Detection using Bacteriophage

Graciela Padua Illinois
Starch-based Multicomponent Nanocomposites

Yuan Yao, Purdue
Dendrimer-like Carbohydrate Polymers: Biosynthesis, Structure, and Functionalization for Food Safety and Nutrition

12:30 – 1:30 pm Poster Session and **BOX LUNCH (Provided for all participants)**

1:45 – 2:45 pm **TOUR of BIRCK NANOTECHNOLOGY CENTER**
Tim Sands

3:00– 3:30 pm **Intellectual Property Issues**
Lesley Millar, OTM, Illinois, and Julie, OTM, Purdue

3:30 – 4:30 pm **Industry Discussion, Feedback, and Example Projects**
Moderated by Richard Linton and Brian Cunningham
Industry Questions
Industry Needs?
What Capabilities help to fit Needs?
Potential Industry Projects?

4:30 pm – 5:00 pm **LIFE Form Review and Discussion**
Irfan Ahmad, Center for Nanoscale Science and Technology, Illinois

Anticipated Companies: Abbott, BAE Systems, Baxter, Elanco, Eli Lilly, J&J, FEI Company, GE, Caterpillar, John Deere, ADM, BASF, Dow AgroSciences, Kraft, Monsanto, Intel, Applied Materials, Beckman-Coulter, Honeywell, and others

Agencies: USDA, FDA, EPA, NIST (to be confirmed)

Consortiums: Nanobusiness Alliance, Illinois Science and Technology Consortium, Illinois Soybean Association

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For more information please email:

Richard Linton, co-PI- Purdue

Linton@purdue.edu

or

Brian Cunningham, co-PI-Illinois

bcunning@illinois.edu

or

Irfan Ahmad at isahmad@illinois.edu





Please forward write-up on need to know basis

**Center for Agricultural and Pharmaceutical Nanotechnology (CAPN)
at Illinois-Purdue**

Project Brief

*PI: Brian Cunningham, Illinois; Co-PI: Richard Linton, Purdue
Co-PI/Industry Liaison: Irfan Ahmad, Illinois*

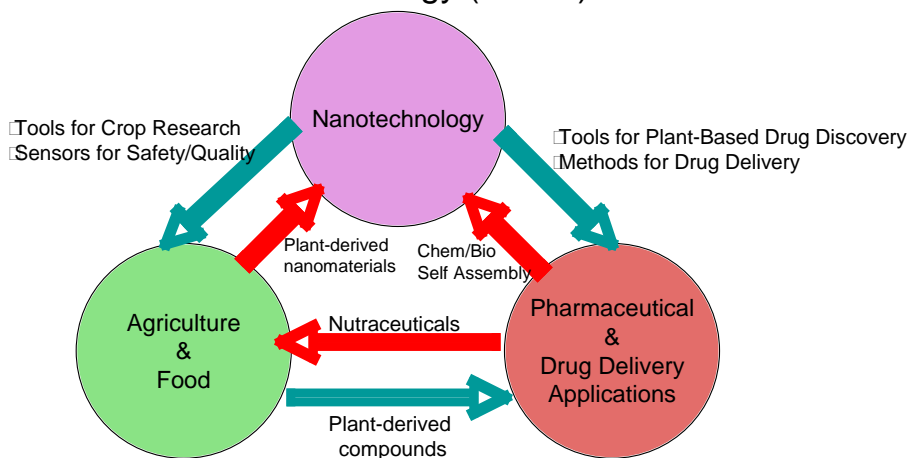
Vision

A large fraction of the world economy is dependent upon the cultivation and processing of plants for a huge variety of uses. In addition to food products that are consumed by animals or humans, agriculture provides our society with the raw materials that are used in treatment of disease, delivery of medication, and materials used in construction, packaging, and clothing. In the past four decades, we have witnessed (and participated in) the development of a fundamental understanding of photosynthesis, and the ability to genetically engineer plants to possess commercially valuable traits. These fundamental advances in Crop Science make it clear that fundamental properties of plants are controlled at the molecular and cellular level – the realm of nanotechnology.

The ability to develop new tools, materials, and methods that enable detection, actuation, and manipulation of agricultural processes will require new collaborations that will bring crop scientists and nanotechnologists together. Nanotechnology provides an excellent opportunity to bring about scientific breakthroughs as well as tools to realize the potentials of agricultural products for quality, safety, and healthcare benefits. ***By focusing at the intersection of nanotechnology, the agricultural sciences, and pharmaceutical research, our vision is to assemble a diverse and complementary set of researchers and industrial partners that are uniquely suited to address several “grand challenge” types of problems*** in food production, agriculturally-derived materials, and health care. The confluence of these three spaces will provide a rich array of research opportunities where nanotechnology-based tools can be used for plant or human-based life science research, plant-derived materials can be engineered at the nanometer scale for disease treatment, and the tools/methods of chemistry can be applied to confer desired functions to nanostructures. The framework in which the flow of basic science and applications among each of the three technical areas (i.e. nanotechnology-based tools providing benefits to Crop Science research in one project, while in another project engineered plant-based materials provide possibilities for new pharmaceutical products) will provide a cross-disciplinary and translational research environment that will attract top researchers and active industrial participation to the Center, while at the same time it will represent a broad research space that can sustain the Center with new ideas for many years. The figure represents how the flow of technology benefits among the three main technical community pillars can provide a rich research environment for participating academic institutions that will help solve problems facing participating industrial institutions.



Center for Agricultural and Pharmaceutical Nanotechnology (CAPN)



Organization

The initial academic research institutions to be involved in the proposed Center are the University of Illinois at Urbana-Champaign, Illinois and Purdue University, West Lafayette, Indiana. Each campus houses leading capabilities in nanotechnology with applications to agriculture and pharmaceutical research. We feel that a Midwestern “core” of academic institutions will facilitate exchange of information and collaboration on research projects, and translation of technologies to health care and agricultural applications. Several large industrial organizations have expressed interest in participating in the Center, as well as several smaller companies.

The combination of three vastly different research fields into a single research center provides a highly complementary environment that can seed new partnerships to address intractable problems. Nanotechnology, Agriculture, and Pharmaceuticals share many linkages that can be exploited to find solutions to these problems. For example, in the field of tissue engineering, researchers are studying and beginning to understand the mechanisms by which cells interact with their physical surroundings, and how cell behavior – including gene expression and differentiation – is modulated by structural contacts at the nanometer scale. These discoveries are leading to new frontiers in efforts to harness stem cells for creating man-made tissues that more accurately mimic the structure and function of natural tissue. Fundamental advances in this area are expected to support important advances in tissue replacement therapy including spinal injuries, heart valve replacement, and even the development of artificial organs. Nanomaterials derived from plant and animal materials represent new approaches in which biocompatible tissue scaffolds may be inexpensively produced with physical features at the nanometer scale that closely approximate natural tissue. Likewise, nanotechnology is beginning to play a key role in the way that drugs are administered to patients. Nanoparticles constructed from safe, biodegradable materials may be infused with therapeutic compounds, and then functionalized with recognition molecules in such a way as to target their delivery to specific areas within the body, such as at the site of a cancerous tumor or at the site of an arterial blockage. Such methods may revolutionize health care for a large class of diseases, enabling the use of new types of therapeutic compounds that may otherwise prove unfeasible, while reducing the incidence of harmful drug side effects to nontargeted tissue. Many pharmaceutical products are derived from plants, e.g., herbal medicines that have been used by





Asians and American Indians for thousands of years. However, due to the complexity of naturally derived herbal medicines, the scientific principles behind the efficacy of them are mostly unknown.

Our proposed Center would leverage the deep expertise in the areas of gene-based and protein-based disease diagnostics. We are approaching an era of “personalized medicine” in which predictions about which individuals will be likely to benefit or suffer harmful side effects from a pharmaceutical compound will be made based upon their gene expression. Pharmaceutical companies will seek FDA approval for drugs based on safety/efficacy as they do today, but rather than for the entire population of humans, a drug will be approved for patients that satisfy a specific set of genetic preconditions, (or “genetic biomarkers”) or the presence of specific expressed proteins (“protein biomarkers”) that are used to conclusively diagnose a disease. These developments will radically change health care in the future, and nanotechnology will play a key role, as nanosensors can be used to rapidly detect gene and/or protein expression at exceedingly low concentrations, providing the tools that will be used to drive this industry. However, the benefits of gene and protein-based diagnostics are not only applicable to human diseases, but the same type of tools can also be applied to understanding and diagnosing crop diseases. Further, these types of tools can be used to aid the process of crop-based genetic engineering that can confer pest resistance, increase yield, or incorporation of genes from other organisms.

Another research area that ties together all three research areas is the use of nanotechnology-based sensors that can rapidly characterize the interaction of plant-derived materials with a wide array of human cancer cells and healthy tissue cells as a high throughput screening method. Such tools can identify plant extracts that may have applicability for cancer treatment, while also identifying the likelihood of toxic side effects on healthy cells.

In the context of the review criteria for NSF research centers, the Center for Agricultural and Pharmaceutical Nanotechnology would provide a rich interdisciplinary research environment, working in concert with industry to solve industry challenges, that supports projects with broad impact on health care and agriculture – two of the most important areas of our society.

Intellectual Merit:

The focus of the new Center will be to develop different technology platforms that can be applied to three substantially important topics requiring strong academic/industry partnership, which will serve as our core competencies: 1). Nanotechnology, 2). Agriculture, and 3). Pharmaceutical Research. While these application areas are diverse, they share a common thread in which underlying scientific principles all require manipulation and design of materials and energy at the nanometer scale. This unique focus on taking the bio-nanomedical developments from the bench level to the commercial arena will help to transform health care and agriculture in highly significant ways.

Broader Impact:

Significant future advances in health care and agriculture will occur at the confluence of biotechnology and nanotechnology, and are encompassed by the scope of the Center. This convergence of frontiers will provide unprecedented opportunity to revolutionize modern medicine and agriculture. These areas will include biomolecular imaging, cell and tissue engineering, advanced drug and gene delivery, development of plants for pharmaceutical purposes, and biomedical devices. The proposed Center is based on departmental strengths





that transcend traditional boundaries, including participation from Bioengineering, Electrical and Computer Engineering, Material Science and Engineering, Agricultural and Biological Engineering, Molecular Genetics, Crop Science, Food Science, Animal Sciences, School of Pharmacy and Pharmaceutical Sciences, and Department of Industrial and Physical Pharmacy, etc. Thus, the Center will help to facilitate collaborative research, education, and preparation of the next generation workforce. The Center will primarily depend on the graduate students for conducting academia-industry relevant research; thus enabling students to become knowledgeable and savvy about industry needs.

The creation of new knowledge will help the US maintain its competitive edge, through the development of novel technology and processes spurring economic growth that help establish sustainable academia-industry relationships in a global context. Technology developed at the Center will also have direct bearing on health care, agriculture, food, and the environment. We will have paradigm-shifting collaborative test-bed projects that harness our industry alliances.

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