M-CNTC
NCI Alliance for Nanotechnology in Cancer

Midwest Cancer Nanotechnology Training Center

m-cntc.illinois.edu

Co-PIs: Rashid Bashir and Ann Nardulli
Program Manager: Laura Miller
Management Support: Irfan Ahmad
Motivation and Vision

- Produce the next generation of leaders who will define the new frontiers and applications of nanotechnology in cancer research.
- More than 1.5 million people were diagnosed with cancer and half a million died of cancer in US alone during 2009 (Cancer Statistics 2009, ACS).
- Limited success in reducing per capita deaths from cancer since 1950.
- New technologies and approaches are needed to address this urgent challenge.
- Response to NCI Alliance for Nanotechnology: M-CNTC
Clinical Partners

- **Central Hub, UIUC**
- Clinical Partner Training Sites
  (UIC, Mayo Clinic, IU School of Medicine, Washington Univ. at St. Louis)
- External Advisory Board Members
  (Stanford University, University of Houston, Georgia Tech, Harvard Medical School)
Participants

External Advisory Committee
1. Bao, Gang Professor/Director Georgia Institute of Technology/Emory
2. Ferrari, Mauro Professor University of Houston
3. Gambhir, Sanjiv S. Professor/Director Stanford University School of Medicine
4. Toner, Mehmet Professor/Director Harvard University/MGH

Remembrance:
With fond memories we remember
Our esteemed colleague and collaborator
Dr. Gary Kruh, Director, UIC Cancer Center
who recently passed away
Focus Area 1: Ex-vivo Diagnostics Nanotechnology
Focus Area 2: In-vivo Imaging Nanotechnology
Focus Area 3: Therapeutic Nanotechnology
Focus Area 4: Mechanobiology and Nanotechnology
• Seed grant program ($400K per year)

• MOU signed on individualized medicine

• Seed grant program

Gary Kruh
M.D., Ph.D.

Susan E. Clare
M.D., Ph.D.

Franklyn G.
Prendergast,
M.D., Ph.D.

George
Vasmatzis,
Ph.D.

George
Vasmatzis,
Ph.D.

Samuel A.
Wickline, M.D.
2010 Pilot Project Grant Guidelines Announced

2010 Pilot Project Grant Program

This pilot project program is made possible by support from the UIC Health Science Colleges and the Office of the Provost.

1. Purpose

To foster high quality interdisciplinary cancer research collaborations between:
- Cancer researchers at Urbana, Peoria, or Rockford and the four UIC Cancer Center research programs; or
- Cancer researchers in the four UIC Cancer Center research programs.

The 4 UIC Cancer Center research programs are:
- Cancer Control and Population Sciences
- Cancer Genes and Cell Signaling
- Experimental Therapeutics and Imaging
- Tumor Cell Biology

Mayo Clinic - Mayo Clinic and University of Illinois Create Research Alliance

Mayo Clinic-University of Illinois strategic alliance for technology-based health care

Tuesday, June 22, 2010

ROCHESTER, Minn. — Mayo Clinic and the University of Illinois at Urbana-Champaign are announcing a strategic alliance designed to promote a broad spectrum of collaborative research, development of new technologies and clinical tools, and design and implementation of novel education programs. Both parties recently signed an agreement establishing the formal relationship.

This Mayo Clinic - Illinois strategic alliance provides a framework for broad cooperation in individualized medicine by integrating efforts in three areas:

- Basic, translational and clinical research
- Bioengineering, especially for point-of-care diagnostics
- Development of tools and methods in computational biology and medicine

"We are utterly delighted to be working with Illinois. We have worked diligently over the past eighteen months to get to this point," says Franklyn Prendergast, M.D., Ph.D., director of the Mayo Clinic Center for Individualized Medicine. "What now emerges is a plan that builds on complementary capabilities of the two institutions in science and medicine honed and strengthened by the similarities in our midwestern cultures and values."
Vision for the M-CNTC Traineeship

• Provide an interdisciplinary and integrative educational environment

• Train pre-doctoral and post-doctoral fellows to be critical, innovative thinkers across disciplines

• Foster leadership, communication, and team building skills to produce future leaders in science and society
Year 1 Trainees

Adeel Ahmad
Electrical and Computer Engineering (4th Year)
PIs: Stephen Boppart and Jimmy Hsia
Investigate the Microenvironment of Cancer Cells and Tissues Using Magnetic Nanoparticles

Muhammad Yakut Ali
Mechanical Science and Engineering (1st Year)
PIs: Taher Saif and Mark Kuhlenschmidt
Study the Effects of Mechanical Stimuli on Cancer Cells

Ross DeVolder
Chemical and Biological Engineering (3rd Year)
PIs: Hyunjoon Kong and Jimmy Hsia
Develop Biomaterials that Elicit Cellular Responses for Biomedical Applications

Michael Gregory
Biochemistry (2nd Year)
PIs: Steve Sligar, Brian Cunningham, and Paul Hergenrother
Develop Next-Generation Therapeutics for the Treatment of Androgen Responsive Malignancies
Year 1 Trainees

**Austin Yin Kyai Hsiao**
Bioengineering (2\textsuperscript{nd} Year)
PIs: Logan Liu and Yingxiao Peter Wang

Study Cancer Cell Mechanobiology in Metastasis

**Huan Li**
Mechanical Science and Engineering (5\textsuperscript{th} Year)
PIs P1: Stephen Boppart and Jimmy Hsia
PIs P2: Hyunjoon Kong and Jimmy Hsia

Probe the Microenvironment of Cancer Cells using Magnetic Nanoparticles

**Sean Sivapalan**
Materials Science and Engineering (4\textsuperscript{th} Year)
PIs: Catherine Murphy and Rohit Bhargava

Develop Highly Sensitive Methods of Detecting Pre-metastatic Cancer Cells

**Li Tang**
Materials Science and Engineering (4\textsuperscript{th} Year)
PIs: Jianjun Cheng and Timothy Fan

Develop Novel Nanoconjugates for Cancer and Diabetes Treatment
Year 1 Trainees

Murali Venkatesan
Electrical and Computer Engineering (5th Year)
PIs: Rashid Bashir and Ann Nardulli

Develop Biomedical Sensors for Early Cancer Detection

Brian N. Y Wong
Materials Science and Engineering (4th Year)
PIs: Yi Lu and William Helferich

Develop Nanoconjugates for In Vivo Cancer Imaging and Drug Delivery
Year 2 Trainees

**Brian Dorvel**  
Biophysics (4th Year)  

PIs: Rashid Bashir and Susan Clare (IUSOM)

Integrated BioChips for Detection of Cancer Proteins from Breast Aspirate Fluids

**William Ilya Goldshlag**  
Electrical and Computer Engineering (3rd Year)  

PIs: Brian Cunningham and Yi Lu

Label-Free Identification of Cancer Cells using Aptamers and Laser-Based Biosensors

**Sarah Holton**  
Bioengineering (4th Year)  

PIs: Rohit Bhargava and Ann Nardulli

Understanding Molecular Crosstalk During Breast Cancer Progression using New 3D Cell Culture Models with Nano-microstructured Detail

**Katrina Keller**  
Bioengineering (1st Year)  

PIs: Rashid Bashir and Supriya Prasanth

Explore Cancer Cell Stiffness and Physical Properties using Silicon MEMS Sensors
Year 2 Trainees

Vahid Mirshafiee
Chemical and Biomolecular Engineering (2nd Year)
PIs: Jianjun Cheng and Mary Kraft

Click Chemistry Induced Nanomedicine Cancer Targeting

Yue Wang
Bioengineering (3rd Year)
PIs: Michael Insana and Steven Boppart

Investigating Mechanoenvironment Change in Tumor Growth Using Multimodal Contrast Agents
Trainee Demographics

• Overall – 16 Trainees have been appointed (2 have graduated)
  – Engineering: 14 (BioE, ChemBE, ECE, MatSE, MechSE)
  – Non-engineering: 2 (Biochemistry, Biophysics)

• Goals
  – Increased participation from trainees outside engineering
  – Include students from underrepresented groups

• Total of 7 new slots for Year 3 trainees to begin Fall 2012
  – Majority of Year 3 Trainees will be chosen from existing PhD students
  – 2 SURGE/M-CNTC Trainees will be new recruits or continuing Master’s students
Components of the M-CNTC Traineeship

1. Co-advisement
   - Ensure scholarly research that is truly interdisciplinary
   - Typically the Co-PI serves as the co-adviser

2. Interdisciplinary Curriculum
   - Interdisciplinary solutions to address complex problems in health care, and especially cancer, call for an interdisciplinary curriculum that will educate and equip a new generation of scientists to face these challenges
   - Intent is to make the program as synergistic with your existing PhD program and requirements
   - Purpose of this two-track system (found on the next slide) is to fill in gaps in your educational background so that you will be ready to start research in this interdisciplinary area as early as possible
   - The interdisciplinarity of each students’ curriculum will be part of the assessment and evaluation of the program
Conceptual Curriculum Schematic

**BioNanotechnology and Nanomedicine: Applications in Cancer and Mechanobiology**

**Cell & Molecular Biology**
- Basic and Advanced Cell Culture
- Advanced Cell Subs.
- DNA and Proteins

**Imaging**
- Advanced Microscopy
- Single Molecule Visual.
- Cell Visualization
- Cell Force Probes

**Nanofabrication**
- Nanofabrication Methods
- Nanofabrication of Cell Sensors
- Micro-fluidics

**Computation**
- Computational Molecular Biology
- Biology Student Workbench

**Lab Modules**
- Cell Structure and Function MCB 400
- Cell Biology for Engineers, MCB new
- Mechanics of Biological Solids, ME 498
- Computational Chemical Biology, BIOP 470
- Non equilibrium Stat. Mechanics, PHYS 598BSN
- Introduction to System Biology for Engineers, ECE 498
- Introduction to Biological Physics, 498Bio

**Career Module**
- Communication skills
- Leadership skills
- S&T Policy
- Patent and IP
- Industry environment
- Entrepreneurship

**Advanced Courses**
- Molecular and Cellular Bioengineering, BIOE 461v
- Mechanobiology for Engineers ME 598
- Physical Biology: From Single Molecule to Sys. Biol., PHYS 5981
- Physics of Nanomachines PHYS 598NM
- Nanotechnology in Cancer Research Seminar Series
- Semiconductor Nanotechnology Lab ECE 583
- Biomedical Applications of Nanotechnology (videolink) BioE 598WL
- Design and Use of Biomaterials MSE 470
- Nanotechnology in Cancer Research Seminar Series
- Biomedical Applications of Nanotechnology (videolink) BioE 598WL
- Veterinary Immunology Pathobiology 632
- Comparative Oncology Pathobiology 555
- Special Topics in Cell Biology MCB 592

**Midwest Cancer Nanotechnology Training Center**
- Two-Track Course Curriculum

**ABE** = Agricultural & Biological Engineering
**BIOE** = Bioengineering
**ECE** = Electrical & Computer Engineering
**MCB** = Molecular & Cellular Biology
**ME** = Mechanical Engineering
**PHYS** = Physics, BIOP=BioPhysics
**TAM** = Theor. & Appl. Mechanics
**VB** = Veterinary Biosciences

- **= Cancer Biology grad programs**
- **= Engineering/Physics grad programs**
- **= All Cancer Nanotechnology Center students**
- **= New Courses**

**M-CNTC**
A University of Illinois Center for Nanoscale Science and Technology (CNST) Collaboratory
Components of the M-CNTC Traineeship

3. Enrollment in “BioNanotechnology and Nanomedicine: Applications in Cancer and Mechanobiology”

— Nanotechnology and Nanomedicine (Rashid Bashir)
  • BioMEMS and Microfluidics
  • Micro and Nanofabrication
  • Lab on a Chip

— Cancer Biology (Ann Nardulli)
  • Characteristics of Cells
  • Metastasis
  • Role of various agents in cancer

— Cancer and Nanotechnology (Catherine Murphy)
  • Therapeutic Nanotechnology
  • Diagnostic Nanotechnology
  • Imaging Nanotechnology

— Cellular Mechanics and Nanotechnology (Taher Saif)
  • Mechano-transduction
  • Forces and measurements
  • Role of mechanical environment on cancer
Components of the M-CNTC Traineeship

4. Summer School
   - Technical modules and hands-on laboratory experience
   - Trainees will be involved in the Summer School at an appropriate level based on experience

   **Key Lecture Topics**
   - Cell and Molecular Biology
   - Cancer Cell Biology
   - Micro and nanofabrication
   - Microfluidics in biology and medicine
   - Neuroscience and Microfluidics
   - Mechanobiology
   - Therapeutic nanotechnology
   - Diagnostic devices and nanotechnology
   - Nanotechnology based imaging in cancer
   - Stem Cell Biology
   - Computational nanomechanics

   **Key Lab Modules**
   - Cancer Cell Biology
   - Molecular Biology
   - Micro and Nanofabrication
   - Micro-fluidics and Enabling Technologies
   - Therapeutic Nanotechnology
   - Mechanobiology
BioNanotechnology Summer Institute 2011

http://www.cnst.illinois.edu/bionanoinstitute.html

BSBA in Taiwan – Summer 2011
http://bsbasi-2011.mechse.illinois.edu

Previous Summer Schools
http://gem4-2009.mechse.illinois.edu/index.php
http://bsbasi-2010.mechse.illinois.edu/
Components of the M-CNTC Traineeship

5. Participation in the Seminar Series and Annual Symposium
   
   – Student Leadership Council (SLC) – comprised of 3 students on a 1-2 year rotation
   
   • Organize seminar series (in conjunction with CMMB IGERT SLC)
   • Attend M-CNTC Executive Committee Meetings
   • Provide a communication channel between/among students and faculty/administration
   • Publicize opportunities for travel grants, professional development workshops, lectures from leading researchers, outreach opportunities, and mentoring programs
   • Organize social events for trainees

   – Seminar series is intended to foster scientific discussion, led and organized by the SLC, invite faculty and trainees to give presentations

   – Annual Symposium
Other M-CNTC Traineeship Activities

• Clinical Partner Experience

• Outreach
  – Engineering Open House
  – Elementary School Tours
  – Brain Fitness Friday’s with TEC
  – Farmer’s Market in Urbana
Outreach Activities – get them as early as we can!

→ Introduction to ‘Nanotechnology’ for 4th – 8th Graders

**MNTL Contributes Expertise and Photos for Children’s Book on Nanotechnology**

*Nanotechnology* is the most recent addition in the series on “Cool Science Careers,” published by Cherry Lake Publishing in Chicago. In addition to explaining the technology and related careers at an introductory fourth-grade level, the book also features several photographs taken at the Micro and Nanotechnology Laboratory (MNTL) at the University of Illinois.

“Our laboratory was originally contacted by Pam Rosenberg on behalf of the publisher, searching for images that can be used on the cover and in the interior of this children’s book,” explained Rashid Bashir, professor in both the Department of Electrical and Computer Engineering and Department of Bioengineering. Photos from a number of research groups’ students and laboratories were used for the book. Bashir and Irfan Ahmad, associate director of the Center for Nanoscale Science and Technology (CNST) at Illinois, both reviewed the book’s content for the publisher. Copies of the book can be ordered by writing to debby@illinois.edu.

**Author: Ann Heinrichs**

Ann Heinrichs is the author of more than 200 books for children and young adults. They cover U.S. and world history and culture, science and nature, and English grammar. Ann has also enjoyed careers as a children’s book editor and an advertising copywriter.

→ Introduction to ‘Bio-engineering’ for 4th -8th Graders
Assessment and Evaluation

• Internal evaluator: Lizanne DeStefano and associates from the College of Education

• The evaluation is designed to answer four questions:
  – Implementation: Is the M-CNTC program being implemented on schedule and as planned?
  – Effectiveness: Are key components of the M-CNTC model (e.g. student recruitment, faculty involvement, introductory course, co-advising, laboratory modules, new courses, seminars, internships, Student Leadership Council, etc.) operating effectively? How might they be improved?
  – Impact: What outcomes are associated with participation in the M-CNTC program? How do these compare with a comparable group of students in traditional programs? What is the value-added of participation in the M-CNTC program?
  – Institutionalization: How and to what extent are elements of the M-CNTC becoming institutionalized at Illinois and other participating institutions? What opportunities and barriers exist?
Assessment and Evaluation

• Pre and Post Surveys (first one goes live September 9, 2011)

• Progress Report Form
  – Summary of research project progress to date
  – Intended outcomes in the next six months
  – Courses taken, scientific meetings attended, talks given
  – Publications
  – Due a couple of months before the end of your traineeship year

• Event Evaluations

• Interviews and Focus Groups

• Interim and Annual Report Data
  – Interim report due December 15
  – Annual report due June 1
Questions and Comments?

m-cntc.illinois.edu

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