



# *Cancer Nanotechnology and Nanotoxicology: Response to NIH RFAs*



***Oct 13, 2015***

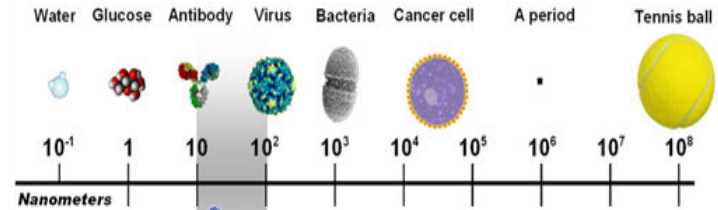
***nanoUtah 2015***

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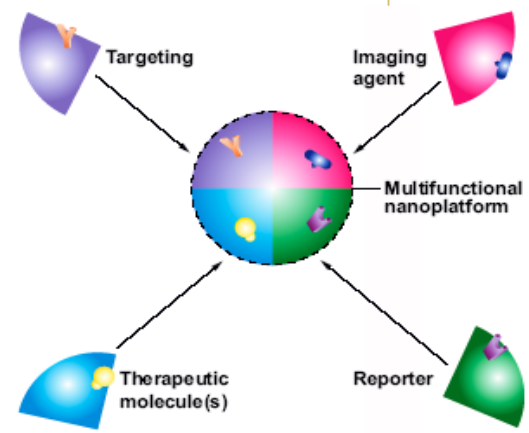


# I. Nanotechnology and cancer research

- Many biological processes including those leading to cancer occur at the nanoscale.
- Advances in nanotech have enabled the *fabrication, visualization, characterization* and *delivery* at the nanoscale.
- Combining the two (nanotech and cancer research) enables us to *detect, understand mechanisms, image, target, and activate* more precisely.



Nanodevices:  
 Nanopores  
 Dendrimers  
 Nanotubes  
 Quantum dots  
 Nanoshells





# NCI Alliance for Nanotechnology in Cancer



➤ Established in 2004

➤ **Mission:** To harness the power of nanotechnology to radically change the way we diagnose, treat and prevent cancer.

➤ **Programs:**

- Center of Cancer Nanotechnology Excellence (U54)
- Cancer Nanotechnology Platform Partnerships (U01)
- Cancer Nanotechnology Research Training Programs (T32)
- Pathway to Independence Awards (K99/R00)
- Nanotechnology Characterization Laboratory (NCL)

[www.nano.cancer.gov](http://www.nano.cancer.gov)



# NCI Nanotech Alliance: Priority Areas

## Prevention and Control

- Delivery of cancer preventing agents
- Multicomponent anticancer vaccines

## Early Detection and Proteomics

- Molecular sensors for detection of cancer-associated biomarkers
- Collection platforms for simultaneous mass spectroscopic analysis of cancer-associated markers

## Imaging Diagnostics

- “Smart” injectable, targeted contrast agents that improve the resolution of cancer to the single cell level
- Nanoscale devices for addressing the biological diversity of multiple cancer cells within an individual tumor

## Multifunctional Therapeutics

- Developing nanoscale devices that integrate diagnostic and therapeutic functions
- “Smart” therapeutic devices that control the spatial and temporal release of therapeutics while monitoring effectiveness

## Quality of Life Enhancement in Cancer Care

- Nanoscale devices that optimally deliver medications for treating conditions that may arise over time with chronic anticancer therapy, including pain, nausea, loss of appetite, depression, etc.

## Interdisciplinary Training

- Cross-training in molecular and systems biology to nanotechnology engineers and in nanotechnology to cancer researchers
- New interdisciplinary coursework/degree programs to train a new generation of researchers skilled in both cancer biology and nanotechnology



# Nanotech at the U: Tools for Cancer Research

## ❑ Nanomaterials

- ❑ Materials for delivery of bioactive and imaging agents to cancer cells, sensing, etc.
- ❑ Can be organic (e.g. polymers) or inorganic (e.g. iron oxide, silica or gold nanoparticles)



## ❑ Imaging, Diagnostics and Therapeutics

- ❑ “The real state of cancer therapy is location, location, location”
- ❑ Multifunctional carriers for delivery and diagnosis (Theranostics)

## ❑ Nanobiosensors

- ❑ Nanometrically engineered surfaces for detection of biomarkers
- ❑ Nanopores embedded in glass membranes for biosensing



## ❑ Gastrointestinal Cancers

- ❑ Often nanotechnology enabled systems are broadly applicable to a wide variety of cancers, e.g., targeting angiogenesis) or can be tailor made (specific overexpression of receptors or exploiting tumor physiology)

## ❑ Nanomedicine & Drug Delivery

- ❑ Drug, gene, imaging agent delivery (polymers, micelles, dendrimers, polymer/gene complexes, nanobubbles, etc.)
- ❑ Nanotoxicology



## ❑ Cell response and regulation

- ❑ Can nanoparticles aid in understanding fundamental cellular mechanisms?
- ❑ How do nanoparticles influence fundamental cellular mechanisms?

## ❑ Interfacial Sciences

- ❑ High throughput sensing for molecular recognition
- ❑ Spectroscopy at interfaces
- ❑ Protein adsorption, phase segregation



## ❑ Nuclear Control of Cell Growth and Differentiation

- ❑ Nanoparticles may interact with nucleus and regulate cell function-They can also provide tools for enabling this research-e.g., high throughput sensing

## ❑ Micro and nanofabrication

- ❑ E.g., nucleic acid, protein and cell-based microarrays
- ❑ Micro and nanofluidics for high throughput



## ❑ Cancer Control and Population Sciences

- ❑ Nano & Personalized medicine
- ❑ Delivery of cancer preventing agents
- ❑ Quality of life assessment with nano-enabled

**Key Challenge: Integration**



## Previous Success @ the U and Future Plans

### **Cancer Nanotechnology Platform Partnerships (U01) (Awarded)**

Magneto-resistive Sensor Platform for Parallel Cancer Marker Detection (Principal Investigators: Marc Porter and Sean J. Mulvihill)

### **Physical Sciences Oncology Network NCI (U01) (Awarded)**

Multi-Tensor Decompositions for Personalized Cancer Diagnostics and Prognostics (Principal/Co- Investigators: Orly Alter and Margit M. Janát-Amsbury)

### **Pathway to Independence Awards (K99/R00) (Awarded)**

Inhibition of Metastasis-Initiating Cells by Chimeric Polypeptide Nanoparticles (Principal Investigator: Mingnan Chen)

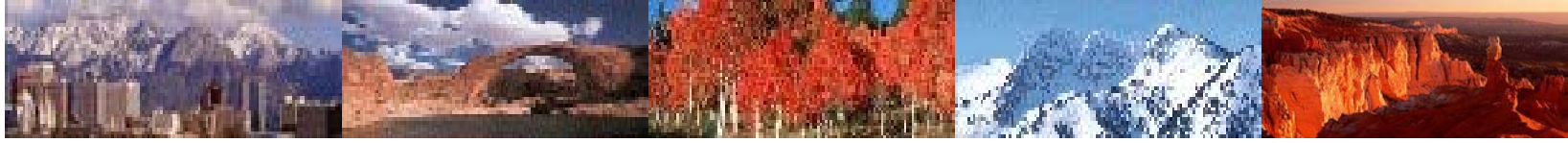
### **Research Training Programs (T32) (Pending Review)**

Utah Training Program in Cancer Nanotechnology  
(Principal Investigators: Hamid Ghandehari and Sean J. Mulvihill)

### **Innovative Research in Cancer Nanotechnology (U01) (To be submitted April 2016)**

<http://grants.nih.gov/grants/guide/pa-files/PAR-14-285.html>

*Scope to be defined; ideas welcome*



## II. Nanotoxicology

### Unwanted Exposure

- Consumer products
- From cosmetics to fuel cells
- Pollution
- Etc.

### Intended Exposure

- Deliberate administration into the body
- Drug delivery systems
- Biosensors
- Imaging agents
- Etc.

### Nanotoxicology:

“The study of the interactions of nanostructures with biological systems with an emphasis on elucidating the relationship between the physical and chemical properties (e.g. size, shape, surface chemistry, composition, and aggregation) of nanostructures with induction of toxic biological responses.”



## Nanotoxicology: Current Funding and Future Plan

- 1) **Biological Fate and Biocompatibility of Dendritic and Silica-Based Nanoconstructs (Awarded)** (PI: Ghandehari, Collaboration with Grainger, Hlady, Moos and Zharov; R01)
- 2) **Nanomaterials Health Implications Research (NHIR): Comprehensive Evaluation of Interactions between Engineered Nanomaterials and Biological System (to be submitted Nov 30 2015)** ES15-012:  
<http://grants.nih.gov/grants/guide/rfa-files/RFA-ES-15-012.html>  
*Focus on routes of exposure*  
*Ideas / thoughts welcome*



# BIRCWH: Interdisciplinary Research in Women's Health

**Internal Submission Deadline: FRIDAY, OCTOBER 16<sup>th</sup>, 2015**

The screenshot shows the BIRCWH website interface. At the top, there is a red header with the University of Utah logo and navigation links for 'HOME' and 'CALENDAR'. On the right side of the header, there are links for 'Log In' and 'Help'. The main content area is divided into two columns. The left column contains the following information: 'Building Interdisciplinary Research Careers in Women's Health (BIRCWH)', 'Internal Submission Deadline: Friday, October 16, 2015' with a 'Print' button, 'Administrator(s): Leanne Johnston (Owner)', 'Category: Intramural Funding', 'Award Cycle: Upon selection', 'Discipline/Subject Area: Women's Health - Sex and Gender influences on health and disease', and 'No. of Potential Awardees: 2'. Below this is a 'Description' section with two paragraphs of text. The right column contains 'Application Tools' with an 'Apply' button, and 'Competition Files' with links for 'Program Outline', 'How to Apply', 'Eligibility', 'Scholar Support', 'Mentors', and 'NIH Biosketch Form'. The footer is a dark grey bar with the University of Utah logo, contact information for the Vice President for Research, and a promotional message for InfoReady Review.

**Building Interdisciplinary Research Careers in Women's Health (BIRCWH)**

**Internal Submission Deadline:** Friday, October 16, 2015 [Print](#)

**Administrator(s):** Leanne Johnston (Owner)

**Category:** Intramural Funding

**Award Cycle:** Upon selection

**Discipline/Subject Area:** Women's Health - Sex and Gender influences on health and disease

**No. of Potential Awardees:** 2

**Description:**

In September 2015 the University of Utah Department of Obstetrics and Gynecology was one of 10 academic Obstetrics and Gynecology departments nationwide to be funded by the National Institutes of Health as a Building Interdisciplinary Careers in Women's Health (BIRCWH) Career Development Center. The funding for this award is via a K12 funding mechanism, extends through 2020, and will support two Scholar positions. The award will generally be for two years per Scholar, although a third year can be considered with appropriate justification.

The goal of the Utah BIRCWH Program is to increase, via a mentored research and career development experience, the number of investigators (Scholars) from the entire spectrum University of Utah junior faculty who will develop successful independent scientific careers as principal investigators. Successful Scholars will, upon completion of the program, be engaged in fundable interdisciplinary research relevant to women's health and sex/gender influences on health and disease.

**Application Tools**

[Apply](#)

**Competition Files**

[Program Outline](#)

[How to Apply](#)

[Eligibility](#)

[Scholar Support](#)

[Mentors](#)

[NIH Biosketch Form](#)

**Vice President for Research**  
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## Goals:

- Anything Women's Health
- The **I** in BIRCWH stands for Interdisciplinary
- 5 year award
- Every 2 years another opportunity for new applicants
- A couple more announcements to follow
- Evenly split between MD, PhD, Pharm D...