Nanomaterials for Nanomedicine

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Engineering College Council, April 1st 2010

The presenter has an ownership interest In Hybrid Silica Technologies, Inc. (HST), which has licensed some of the technologies presented here.

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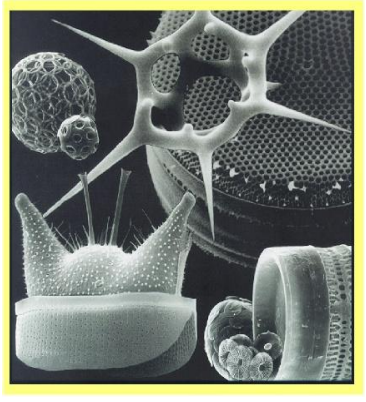
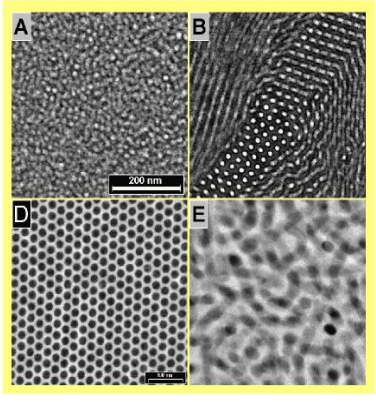
The Wiesner Research Group

Organic-Inorganic Hybrids with Nanoscale Structures





Science **278** (1997), 1795
Science **305** (2004), 1598
Science **320** (2008), 1748
Science **330** (2010), 214

Nature Mater. **6** (2007), 156
Nature Mater. **7** (2008), 222
Nature **460** (2009), 1110

Energy conversion and storage
Clean water
Diagnostics & Nanomedicine

Cancer Treatment Today

- There is no engineering parameter that helps surgeons to decide what to take out and what not
- Chemotherapy has substantial side effects

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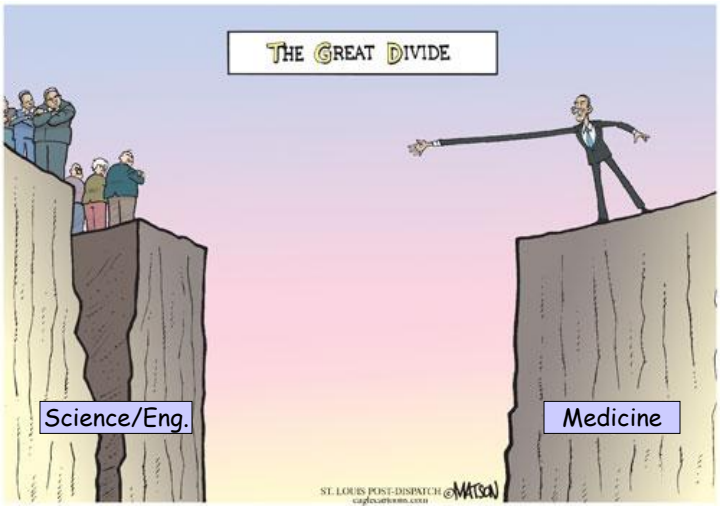
Bridging the Physical Distance

Bridging between Disciplines



highly interdisciplinary: plays into Cornell's strength

Clinical Imaging Today

MRI

CT

PET

large, expensive equipment

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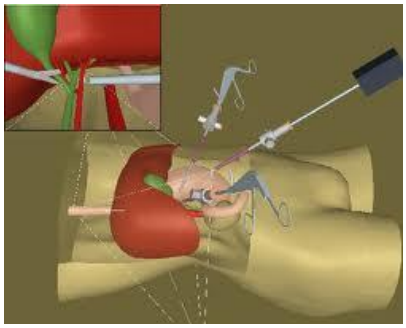
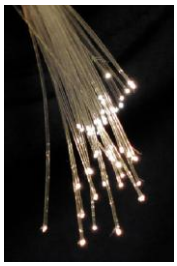
Minimally Invasive Surgery



miniaturization of optical imaging equipment possible



Integrating optical imaging in surgical instruments

What's missing: effective optical imaging probes

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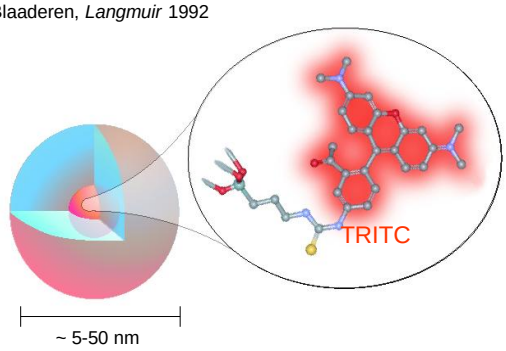
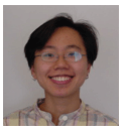
Cornell dots (C dots)

Fluorescent Core-Shell Silica Nanoparticles

Rhodamine dye
van Blaaderen, *Langmuir* 1992





Sweng Ow

H. Ow, UW *et al.*, *Nano Letters* **5** (2005), 113
Editor's Choice, *Science* **307** (2005), 18
A. Burns, UW *et al.*, *Chem. Soc. Rev.* **35** (2006), 1028

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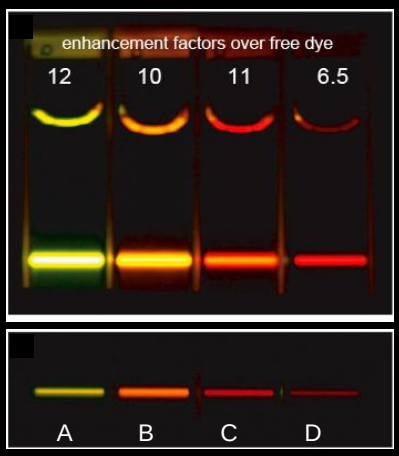
Super-bright fluorescent probes: diagnostics

Webb & Wiesner

dye cost:
~$200/mg



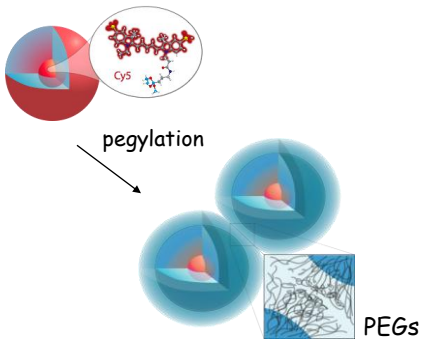
Erik Herz

E. Herz, U.W. *et al.*, *Macromol. Rap. Commun.* **30** (2009), 1907

A Translatable Platform: "Target or out"

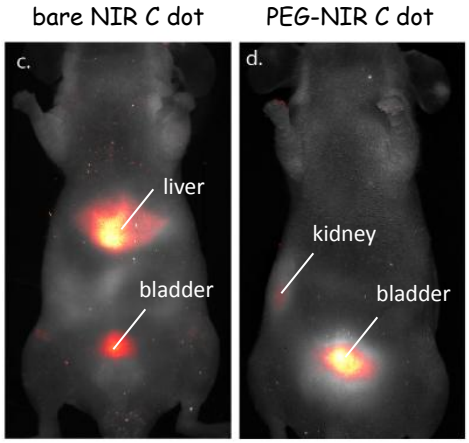
NIR C dots with sizes < 10 nm

hybrid silica technologies



Memorial Sloan-Kettering Cancer Center

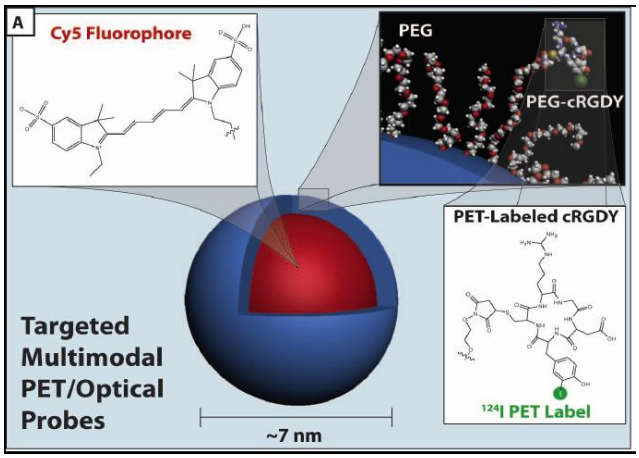
Bradbury, Larson, Ow & Wiesner



A. Burns, U.W., M. Bradbury *et al.*, Nano Lett. **9** (2009), 442

Dual-Modality *C* dots for Targeting

providing multifunctional probes for personalized medicine



M. Bradbury, U.W. *et al. (2011), submitted*

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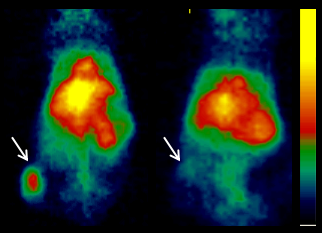
New paradigm for pharmaceutical industry:

particle platform technology

Bradbury, Larson & Wiesner

4 h post



Representative whole body PET image of M21 ($\alpha_v\beta_3$ integrin-positive) and M21L $\alpha_v\beta_3$ integrin-negative, CONTROL) tumor-bearing mice 4 hrs after i.v.-injected RGD-dots (arrow, right hindleg tumor)

Fall 2010: first ever inorganic nanoparticle to get FDA IND approval for human trials !

Memorial Sloan-Kettering Cancer Center

M. Bradbury, U.W. *et al. (2011), submitted*

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hybrid silica technologies

http://www.hybridsilica.com/

2004: licensing agreement with Cornell

2005: HST opens lab in Cornell incubator space (Langmuir labs)

2010: HST opens lab in Cambridge, MA

2010: First products: C•specs™

2010: FDA IND approval for first human trials

2011: ongoing negotiations with Cornell to form a new company: CST

to date: no VC money in HST

Urgent need to improve Cornell's support for entrepreneurial activities

- global shift from large, industrial R&D centers to academia as essential drivers for innovation
- significant shift in metrics for the ranking of top universities
- Cornell's special and relatively strong position within weak Upstate New York economy
- associated faculty hiring and retention issues
- growing student and faculty body interested in engaging in entrepreneurial activities

➔ Cornell's Engineering College should lead these efforts

➔ We need a $100 million commitment to build a leading-edge research and commercialization center as a nucleus