FOSTERING NANOTECHNOLOGY INNOVATION THROUGH EMERGING NANOSCIENCE

Moderators: James Rudd (NSF) and Rich Chapas (Battelle)

Short statements:
Alden Bean (CIMS, North Carolina State Univ.)
Les Alexander (A123 Systems)
Edward Ahn (Pioneer Surgical)
Charlie Gause (Luna Nanomaterials)
Doug Schulz (North Dakota State U. CNSE)

Fostering Nanotechnology Innovation Through Emerging Nanoscience Workshops

Alden S. Bean, CIMS/NCSU, 04/02/2009

- **For NNI Center research faculty and their industrial partners TOGETHER**
- **Promotes mutual understanding of 'Common Ground'**
- **Creates a common language for exploring different pathways---**
  - for advancing science
  - for building businesses
  - for mutual benefit
- **Builds Faculty knowledge of commercial needs and opportunities**
- **Enriches Industry appreciation for unique S&T capabilities**
- **Shortens concept-to-market cycle time**
- **Produces Useful new ideas for collaboration right away**
- **Promotes lasting alliances**

Fostering Nanotechnology Innovation Through Emerging Nanoscience Workshops

Alden S. Bean, CIMS/NCSU, 04/02/2009

- **Developed in Partnership with the Industrial Research Institute**
- **Supported by a 'Partnership for Innovation Grant' from the NSF**
- **Tested with NNI Centers & affiliates from: Carnegie Mellon, Georgia Tech, Lehigh, Michigan State, North Carolina State, Northeastern, Penn State, Purdue, UMass at Lowell, Univ. of New Hampshire, and Univ. of Pittsburgh**
- **5 separate workshop events; 177 individual participants; 44 companies**
- **Arranged directly through NNI Centers or through Regional Consortia**
- **Modular format customized to the needs and interest of the NNI Center**
- **Typically 2 days in length, 30-50 participants, equal split**

Fostering Nanotechnology Innovation Through Emerging Nanoscience Workshops

Alden S. Bean, CIMS/NCSU, 04/02/2009

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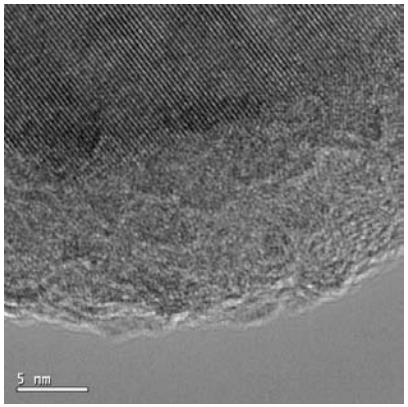
/ echnologies’



From Science to Manufacturing

Les Alexander
Operations Manager

Government Solutions Group

Material science differentiation → *Cell engineering innovation* → *Systems engineering value add* → *Low cost - high volume & quality manufacturing* → *Industry leading partners*

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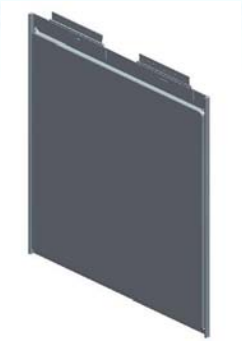
power. safety. life. ™

M1 26650 cell

32113 HEV Cell



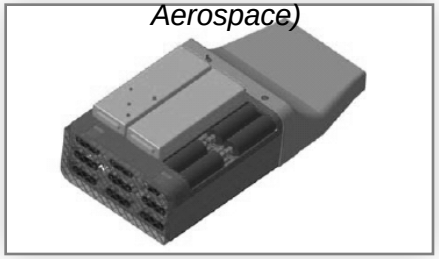
PHEV EV Prismatic Cell

Cordless Power

Grid stabilization

Transportation

(Passenger, Heavy Duty, Aerospace)



MATERIAL COVERED BY NDA with FORD December 1, 2007 EXECUTED 11/26/2007

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- What regional, state, or local programs best support your company's nanotechnology development plans, and how could they be improved?
  - Michigan 21st Century Jobs Fund help create a Center of Energy Excellence to study manufacturing
  - Local Non Profits matching SBIRs
  - Tax Credit Incentives from State and Local
  - DOE Funding manufacturing for the Battery Industry through Stimulus Funding
    - IMPROVEMENTS: Streamline contracting process, stimulate equipment manufacturers, support raw material development.

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- What other models and approaches would effectively foster nanotechnology innovation in your industry and your region?
  - Expand funding for basic research beyond SBIR to large businesses
  - Funding for more pilot scale manufacturing in the US.
  - Development of more North American raw material sources

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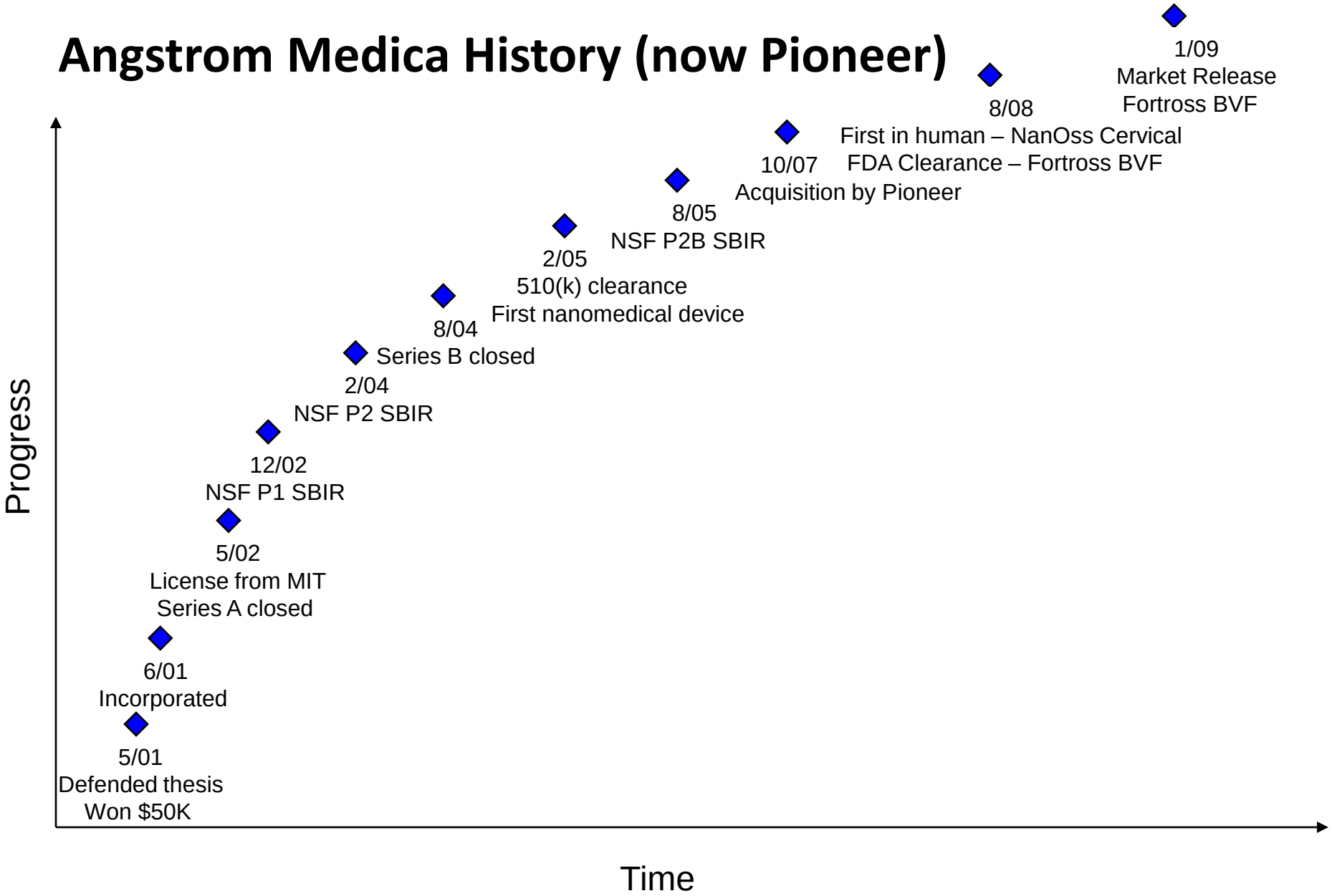
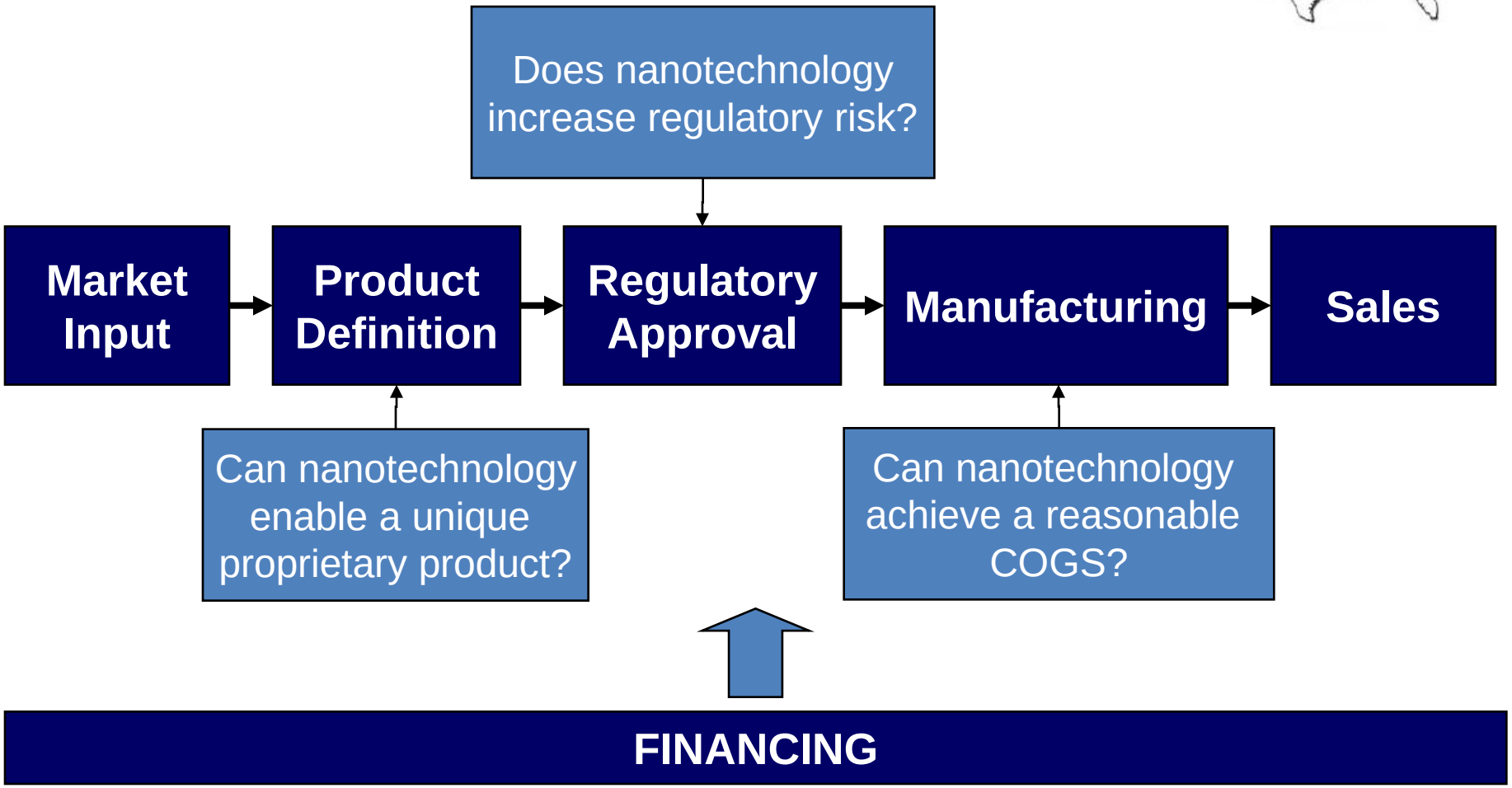
Angstrom Medica History (now Pioneer)



Edward Ahn, Pioneer Surgical

Nanotechnology and the Medical Device Company



Edward Ahn, Pioneer Surgical

Fostering Nanotechnology Innovation

- **What regional, state, or local programs best support your company's nanotechnology development plans?**
  - Educational Institutions: MIT, Harvard, BU, Tufts, etc.
  - Hospitals: MGH, BWH, BID, etc.
  - MIT Technology Licensing Office
  - MIT $50K Business Plan Competition
  - MIT Enterprise Forum
  - MIT Venture Mentoring Service
  - First Founders, Ltd
  - Trade Assoc: MassMedic, MassBio
  - Venture Capital
  - Law Firms
- **How could they be improved?**
  - No nanotechnology innovation focus per se
  - No state support
  - IP stuck in TLO

Fostering Nanotechnology Innovation

- **What other models and approaches would effectively foster nanotechnology innovation in your industry and your region?**
  - Nanotechnology clearinghouse of government sponsored academic research
  - Regional NSF grantees conference
  - Coaching between SBIR awardees

Charles Gause, Sr VP
Luna Innovations Incorporated, nanoWorks Division
gausec@lunainnovations.com

April 2009

Luna nanoWorks' Division

Making products empowered by nanomaterials

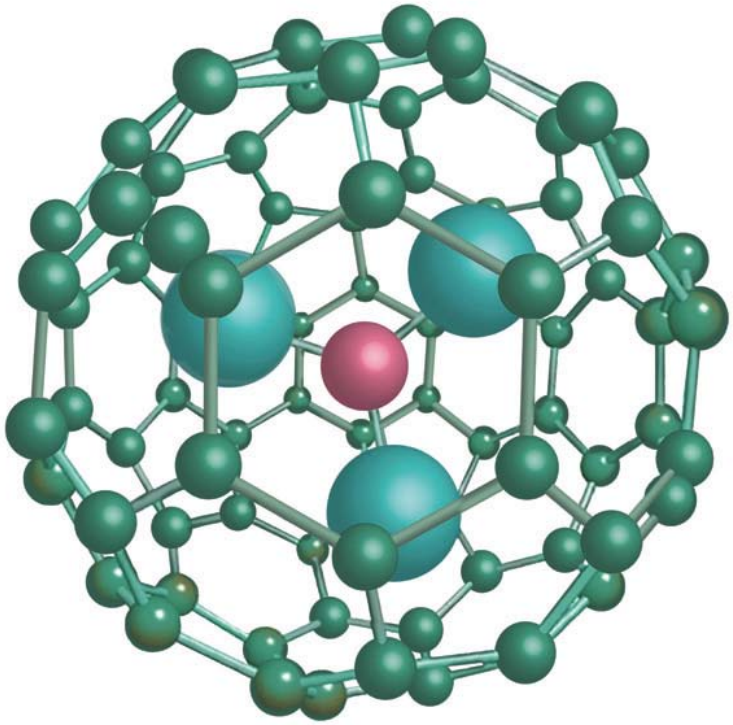
5 years of Nanotechnology in Danville Virginia!

LUNA INNOVATIONS

Trimetasphere® Nanomaterials

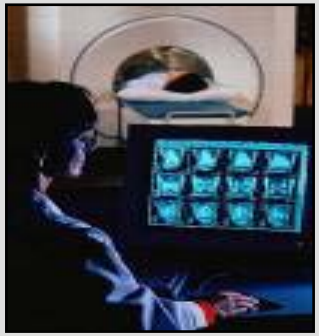
- A sphere of 80 carbon atoms enclosing a metal nitride core
- Strong IP
- Unique physical properties:
  - *Chemical*
  - *Biological*
  - *Thermal*
  - *Optical*
  - *Magnetic*
  - *Electronic*

TRIMETASPHERE®
Luna's Exclusive Carbon Nanomaterials



Product Development

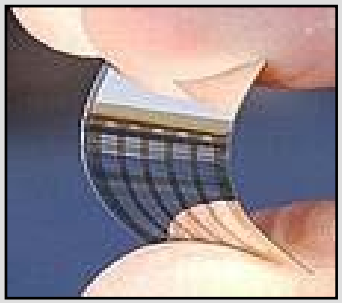
Diagnostics



Imaging agents providing enhanced contrast and better safety:

- **MRI**
- **MRI targeted (i.e. plaque, brain, etc.)**

Energy



Providing for more efficient & less expensive organic solar power solutions.

LUNA INNOVATIONS

Support

- Local - Highly motivated (2004-05): 13% unemployment compared to 3.7% for Virginia with aging population & outward migration of youth.
  - *Available workforce and close to RTP*
  - *Low cost of doing business and available space*

- State – Virginia Economic Development Partnership & Tobacco Indemnification Commission
  - *Legislature – JCOTS, CIT, regional initiatives – Tech Councils*
  - *Universities – VT, UVA, W&M, ODU, JMU, VCU, etc.*
  - *DCC – workforce training via MET program*

- Regional - great location to interface
  - *Emerging Technology Forum*
  - *NoVA & DC – Federal*
  - *Universities – VA, I-40 Corridor NC, MD, etc.*
  - *Nanobusiness Alliance*

LUNA INNOVATIONS

Opportunities

- ARRA
- NNI renewal
- NSF Centers
- SBIR/STTR utilization
- Risk capital
- Alignment with local economic development
- Teaming with Local Universities & Gov't Labs
- Participation in Federal Programs (i.e. ITP Nanomfg, NIH NanoHealth Enterprise)
- Teaming with larger corporations
- Commercialization

LUNA INNOVATIONS®

inspired by ideas…driven by markets

www.lunainnovations.com

Fostering Nanotechnology Innovation at NDSU-CNSE

Doug Schulz

Senior Research Scientist – CNSE
Adjunct Professor – Mechanical Engineering Department
Director – Center for Surface Protection – Hard Coatings
PI – NSF EPSCoR Flexible Electronic Materials Program

Panel Presentation
Regional, State, and Local Initiatives in Nanotechnology
NNI nanoRegional Workshop

Oklahoma City, OK
April 2, 2009

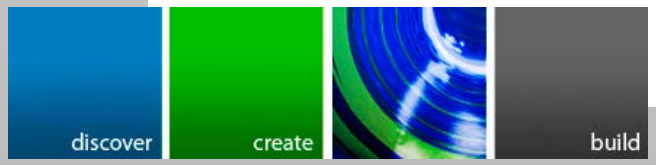
CNSE NDSU Center for Nanoscale Science and Engineering

North Dakota State University

North Dakota's Land Grant College
Founded in 1890
Division 1A, Ph.D. granting (40 programs)
12,500/1,800 under/graduate students
2006 research expenditures $103M

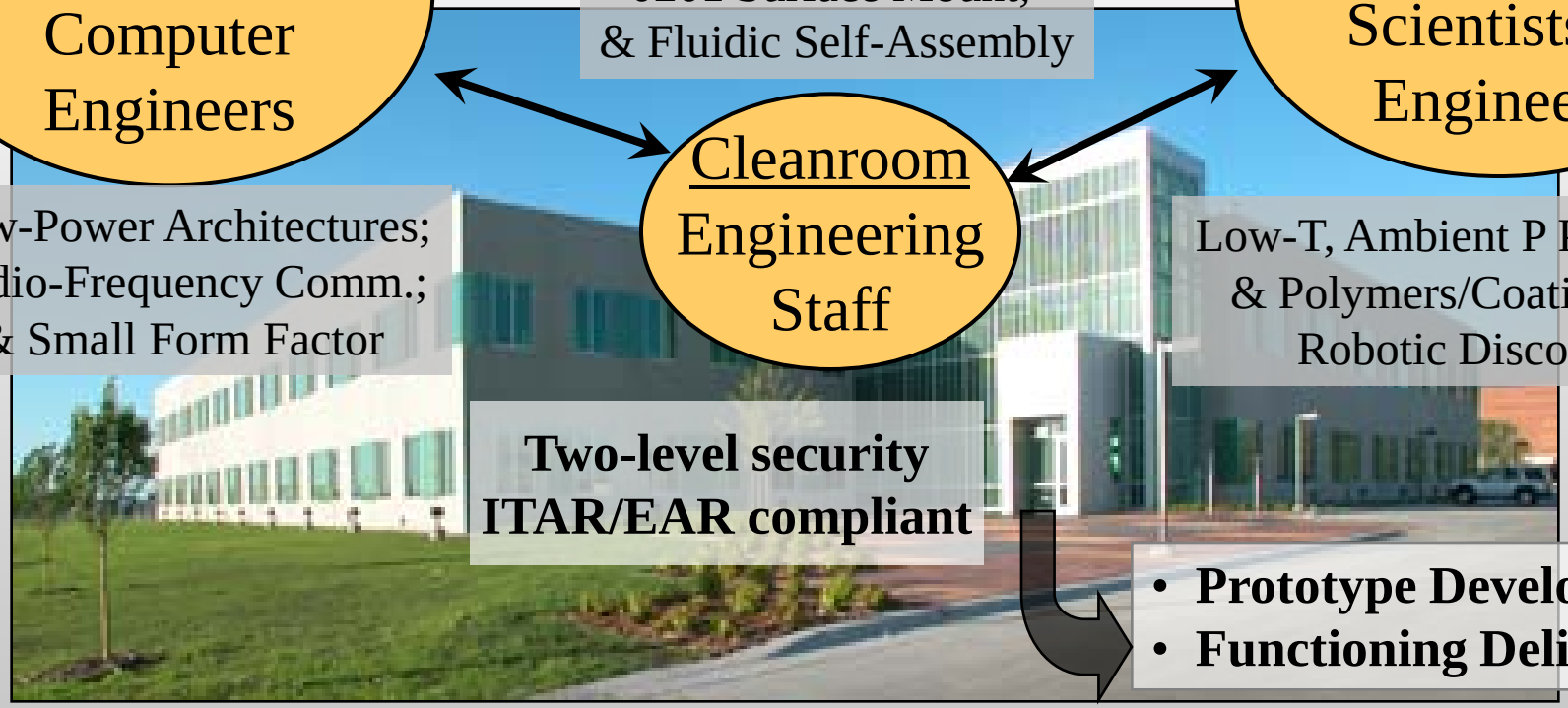
NDSU - Research, Creative Activities and Tech Transfer

formed in March 2000 – Philip Boudjouk, VP



NDSU Research Tech Park (2001)
More than 425 people come to work each day
Research 1 Building (2002)
RCATT SPA/Bus.Dev./Tech.Trans & coatings labs
Research 2 Building (2004)
CNSE – 6,350 ft^2 cleanroom, $21M toolset
NDSU is ranked 127 of 640 Research Universities
Top 100 in chemistry, physical sciences, psychology, ag sciences, social sciences
[Source: National Science Foundation – FY06 R&D expenditures]

NDSU-CNSE Operations at the Research 2 Building



West Wing
Electronic & Computer Engineers

South Wing
Materials Scientists & Engineers

Chip Scale Packaging; 0201 Surface Mount; & Fluidic Self-Assembly

Cleanroom
Engineering Staff

Low-Power Architectures; Radio-Frequency Comm.; & Small Form Factor

Low-T, Ambient P Processes; & Polymers/Coatings via Robotic Discovery

Two-level security
ITAR/EAR compliant

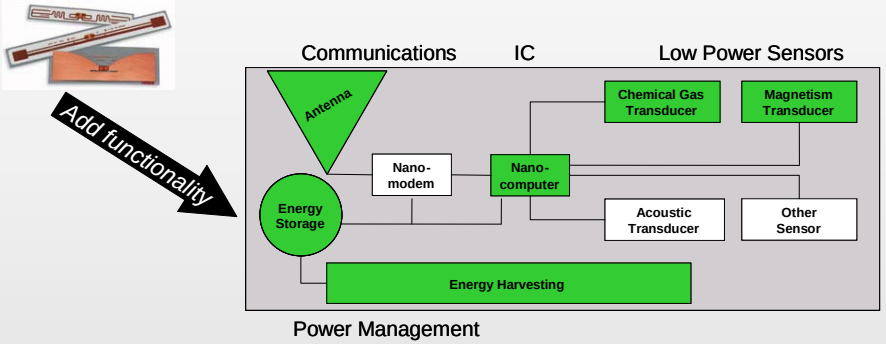
- **Prototype Development**
- **Functioning Deliverables**

NDSU Partners

ALIEN. 3M DUPONT Honeywell Microsoft AKZO NOBEL TESSERA JOHN DEERE Pfizer CRANE Bobcat smiths detection bringing technology to life

NSF EPSCoR – Flexible Electronic Materials (FlexEM)

Project Goal: Discover new materials and develop new deposition processes that revolutionize Flexible Electronics



Markets

RFID sensors (left)
Photovoltaics
e-paper
Health monitoring

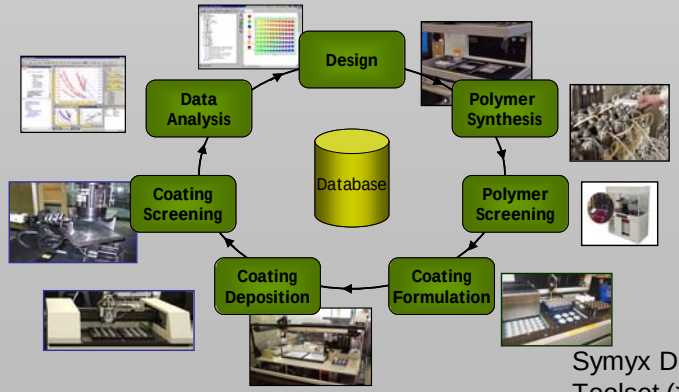
Three Thrusts

Transparent Barriers

Materials, Characterization, Modeling, Lifetime

D. Webster B. Tande K. Katti D. Katti S. Croll

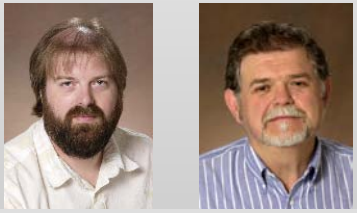
NDSU-CNSE Combinatorial Materials Research Lab



Symyx Discovery Toolset (> $10M)

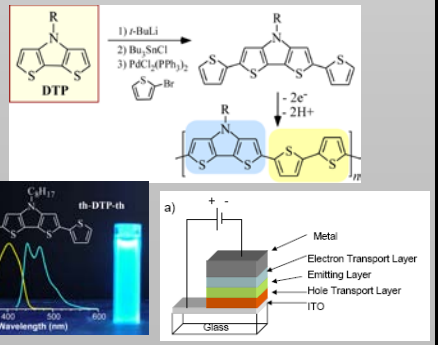
Conjugated Polymer

Materials, Devices



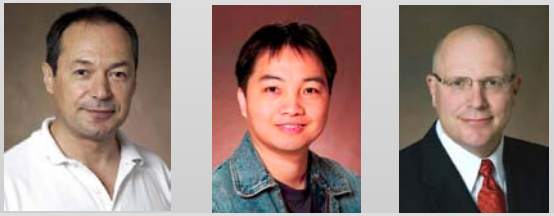
S. Rasmussen K. Pokhodnya

Dithienopyrrole-based OLEDS



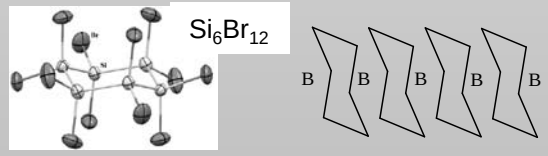
EM from Liquid Silanes

Materials, Printing Methods



I. Akhatov X. Dai D. Schulz

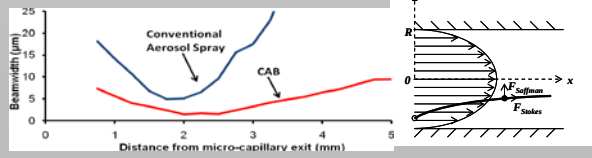
Lewis-adducts



New Allotrope of Si

X@Si_{60} Fullerenes, Si SWNTs

Collimated Aerosol Beam Direct-Write



Q1) What regional, state, or local programs best support your company's nanotechnology development plans, and how could they be improved?

ND Governor John Hoeven's Center of Excellence Program (2005 – present)

The *Centers of Excellence* program is the product of Gov. Hoeven's initiative to **combine education and economic development to create higher paying jobs and new business opportunities for North Dakota citizens**. The Centers are hubs of research and development on the campuses of North Dakota's 11 colleges and universities. Their objective is to research, develop and commercialize products and services to create good paying jobs for the citizens of our state, especially our young people.

http://governor.nd.gov/init/ce-init.html

Economic Development Center of Excellence (EDCOE) Program

- Matches 2:1 resources contributed from industry for research/commercialization
  - ND State match is in cash.

NDSU Center on Surface Protection – Hard Coatings

Develop technologies that enable cost-effective manufacture of wear-resistant coatings

- Serve at the intersection of hard coatings companies and ND industry
  - State-of-the-art characterization facilities at the NDSU RTP
  - Expertise from NDSU scientists and engineers
- Commercialize next generation hard coatings
  - New North Dakota business ventures
  - Strategic relationships with existing entities
- Currently funded at $2.6M in match from NDEDC

http://www.ndsu.nodak.edu/csp

Q2) What other models and approaches would effectively foster nanotechnology innovation in your industry and your region?

Proposals to join existing MRSEC Interdisciplinary Research Groups

- Expedite transition of discoveries at RSL level by leveraging existing IRGs
- Technical review team could include IRG members

More Transparent Valuation of IP of National Importance

- Limitations in the usage of Federal Funds
  - Little to no marketing support at most Universities
- Prioritize technology development
  - Better estimate of potential with screening done accordingly

“Standard” IP Language that Guarantees Up-Front Benefits to Partners

- Remove barriers to University-Industry-National Lab partnerships
- Reduce the time required to negotiate Research Agreements
  - Fewer lawyer fees