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CNS Global Diffusion Team

**Goal:** Identify, characterize and analyze the global diffusion of nanoscience and technology

**RQ:** Where are the emerging hubs of nanoscience? How are they innovating and commercializing in this area?

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**Research team**

**Faculty**
- Rich Appelbaum (UCSB)
- Gary Gereffi (Duke)
- Francesca Bray (Edinburgh)
- Brad Chmelka (UCSB)
- Tim Cheng (UCSB)

**Grad/Research Staff**
- Rachel Parker, UCSB
- Ryan Ong, Duke
Global Diffusion of Nanotech

- **Governments are investing in R&D**
  - 2005: government funding reached $5 billion globally
  - US National Nanotechnology Initiative: proposed budget of $1.5 trillion for FY 2008
  - Key players: US, Japan, Germany

- **Nanotech growing in developing world.**
  - 2005: China spent more than $250 million on nanotech R&D (Lux)
  - Key players: China, Taiwan, South Korea, Russia
Data Sources

- **Secondary:** publications, websites, recent reports
  - Demos, Lux Research, Council on Competitiveness

- **Fieldwork in China:** 30+ interviews with scientists, engineers, and policy-makers (summer 2006):
  - National Center for Nanoscience and Technology (Beijing)
  - Shanghai Nanotechnology Promotion Center
  - Nanotechnology Industrialization Base of China/China National Academy of Nanotechnology & Engineering (Tianjin)
  - Shanghai Jiao Tong, Fudan and Peking Universities
  - Chinese Academy of Sciences (various locations)
  - IMMS, IC-DFN meetings in Shanghai
National Nanotech Platforms

- **National Steering Committee for Nanoscience and Technology (2000)** – to oversee national policy and planning

- **National Engineering Research Centers for nanotechnology**
  - Shanghai (SNERC): 10 major shareholders (CAS Institutes, universities, firms, Shanghai Nanotech Promotion Center)
  - Beijing: never got off the ground

- **National Center for Nanoscience and Technology (NCNST) – Beijing**
National Center for Nanoscience and Technology (NCNST)

- Founded in 2003, under Chinese Academy of Sciences, Tsinghua and Peking Universities
  - Support from Ministry of Science and Technology, Ministry of Education, and National Development & Reform Commission

- **Primary concerns:**
  - Funding basic research and instrumentation (no product development)
  - Enable collaboration between nanoscientists/engineers
  - Develop common standards for work at the nanoscale

- Work concentrated in: nanomaterials/ nanostructures, nanomedicine/ nanobiotechnology, and nanodevices.
Nanotechnology Industrialization Base of China (NI BC)/China National Academy of Nanotech & Engineering (CNANE)

- **CNANE** and **NI BC** in same facility (Tianjin), same administration
- Funding from Chinese Academy of Sciences, universities, and private enterprise
- **CNANE**: basic research, R&D
- **NI BC**: commercialization; incubator for commercial spin-offs in Beijing metro
- **Potential applications**: novel materials, medical diagnostics/treatment, drug delivery, new (lighter) aircraft, cleaner energy, air/water filtration
Commercialization in China: Areas of Progress

- **Self-cleaning glass**: Beijing Concert Hall
- **“Nano-refrigerators”** with interior coatings that absorb odors
- **Air conditioners** that filter out organic materials
- **Conductive and anti-corrosive coatings** for oil tanks (Shenzhen Nanotech Port Company)
- **Pavement coatings** that filter out vehicle exhaust (Olympic venue parking lots)
Commercialization in China: Areas of Weakness

- Commercialization remains limited: nanotech largely in R&D phase
  - Progress impeded by state-managed industries wary of innovations with long-term ROI (15+ years away?)
- Intellectual property issues/protections
- Pressure to produce/publish (quality, fraud)
- Limited infrastructure (e.g., nano fabrication facilities); inadequate funding
- Inadequate funding: limited government funding; lack of private venture capital
Nanotech Publications Are Growing...

Figure 1: China and U.S. Nanoscience and Nanotech Article Output, 1988-2005

source: CNS analysis of database of more than 14,000 nanotechnology articles in 81 high-impact science and engineering journals
...but impact is still weak.

- **Citations Per Paper, 2001-2003**
  - China: 2.28
  - Japan: 3.70
  - Germany: 4.54
  - United States: 6.56

- Is this number rising?

Source: Bai Chunli, *Science* July 2005
Weaknesses of China’s Nanoscience

- imitation, rather than innovation
- intellectual property issues/ protections
- pressure to publish
- limited infrastructure (e.g., nano fabrication facilities)
- inadequate spending
Figure 2: Landscape of Chinese Nanoscience 2003-2005

source: CNS analysis of shared citations
Nanotech Value Chain

CNS Innovation Team (WG2)

Goal: Optimize sustainable innovation and its policy framework for nanotechnologies

RQ: How is nanoscale R & D changing the existing innovation system?

Research team

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- Dave Seibold (UCSB)
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- David Mowery (UCB)
- Gerald Barnett (UCSC)

CNS Grad Fellows
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- Aaron Rowe, Chem
- Jerry Macala, Chem
- Alan Glennon, Geog
WG2-Innovation Research

Years 1-2 Projects: Nanoscale Innovation Flows

- **Mapping the Nano-Enterprise**: West Coast -> Pacific Rim; university-industry emphasis; new enterprises
- **Strong and Weak Innovation Currents**: Where is technology moving well? What helps and hurts this movement? *Interviews with nanoscale participants (PIs, Tech Managers, grads, industry)*
- **Improving Innovation Climate**: beyond transfer, how do we fund, build and sustain “multi-local” research communities? *Policy research combined with lab field study.*
WG2 Innovation Team: Mapping California Nano-enterprises