

Nanotechnology:

Perspectives on the State of the Art and Intellectual Property

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Overview

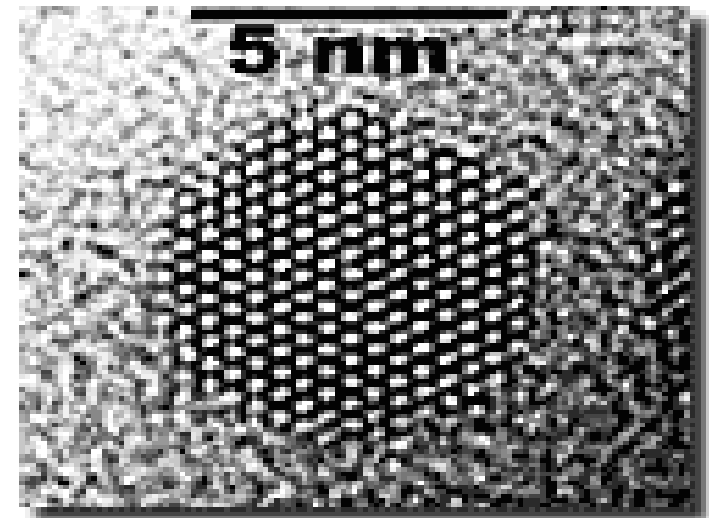
- Nanotechnology 101
- Nanotechnology Business Environment
- Nanotechnology Intellectual Property

Nano 101

Definitions

- What is Nanotechnology?

Typically, dealing with “things” ranging from a few nanometers to hundreds of nanometers.



Perspective

A nanodot is to a crumb, as a basketball is to the Earth (roughly speaking and depending on the size of the crumb)

5nm Quantum Dot
(viewed through a transmission electron microscope)

Nano 101

Definitions

“Research and Development at the atomic, molecular or macromolecular levels, in the length scale of approximately 1-100 nanometer range, to provide a fundamental understanding of phenomena and materials at the nanoscale and to create and use structures, devices and systems that have novel properties and functions are developed at a critical length scale of matter typically under 100 nm. In some particular case, the critical length scale for novel properties and phenomena may be under 1 nm (e.g., manipulation of atoms at approx. 0.1 nm.) or be larger than 100 nm. (e.g., nanoparticle reinforced polymers have the unique feature at approx. 200-300 nm. As a function of the local bridges or bonds between the nanoparticles and the polymer.”

- *Definition provided by the U.S. Patent Office at Nanotechnology Partnership Meeting*

Perspective

“Things” are not as simple as they may seem.

Nano 101

Applications

Life Sciences

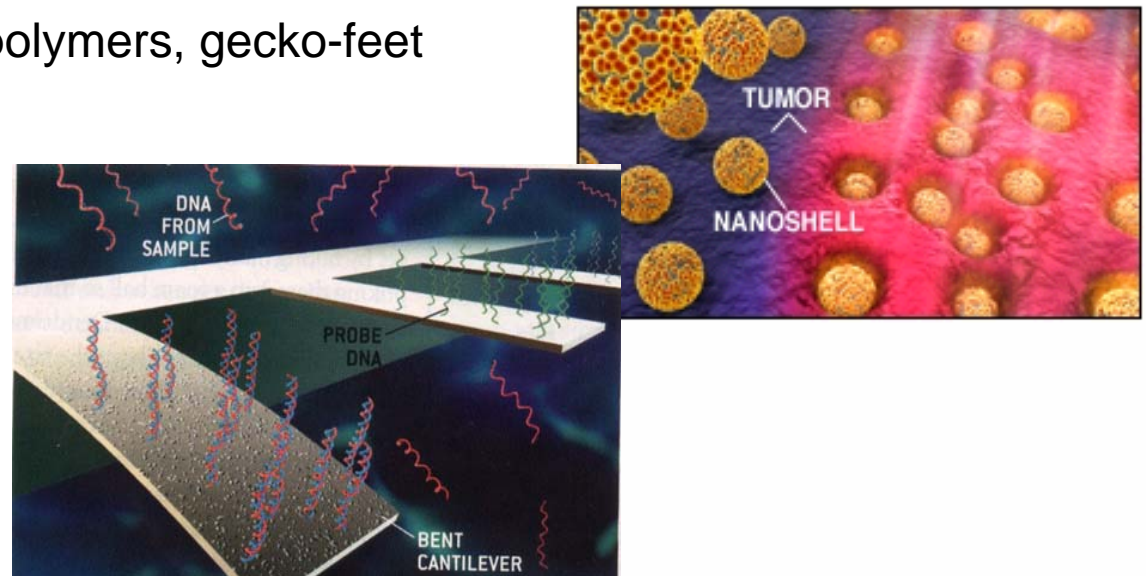
e.g., drug delivery, lab-on-a-chip, drug design

Security

e.g., molecular level barcoding, chemical detection

Materials

e.g., powders, polymers, gecko-feet



Nano 101

Applications

Electronics

e.g., LCDs, Semiconductors, Memory

Energy

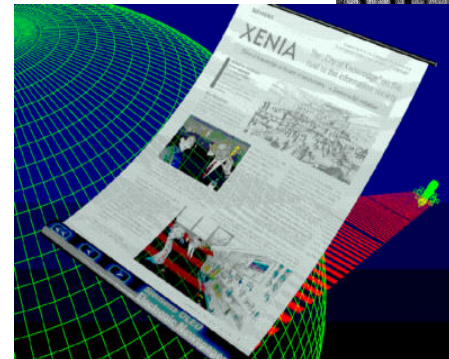
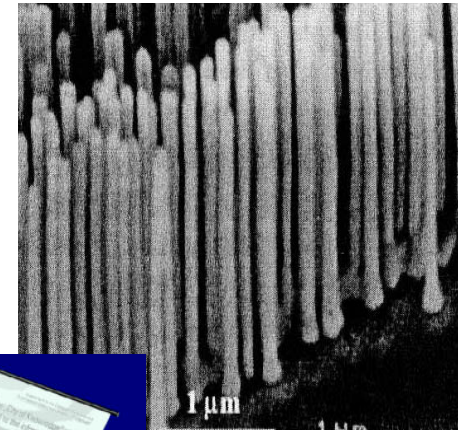
e.g., solar cells, fuel cells, membranes

Nano Tools

e.g., STMs, AFMs

Perspective

Nanowires



Flexible Displays

The wide range of applications is one force driving the excitement surrounding nano.

Nano 101

History

“It is a staggeringly small world what is below. In the year 2000, when they look back at this age, they will wonder why it was not until the year 1960 that anybody began seriously to move in this direction.”

Richard P. Feynman, 1959

Perspective

Nanotechnology has been around for a long time.

Nano 101

Recent History

2000 – National Nanotechnology Initiative

2001 – Nanobusiness Alliance Launched

2003 – First U.S. Patent and Trademark Office
Nanotechnology Partnership Meeting

2003 – \$3.7B 21st Century Nanotech Research and
Development Act

2004 – (Lots of) Talk of the First
Nanotech IPO

Perspective

*Nanotech has reached
a commercialization
inflection point.*

Nano Business Environment

Hype v. Reality

- “Nanotechnology will revolutionize the biotech, medical, and pharmaceutical industries. This may reduce sickness and suffering . . . and increase life expectancy.” - *U.S. Patent Office*.
- “It is one of the most promising and exciting fields in science today.” – *Senator Boehlert, Senate Science Committee Chairman*
- A potential IPO for Nanosys has been compared to the IPOs of Microsoft, Netscape and a potential Google IPO. – Front Page of U.S. Today Business Section, Dec. 4, 2003.

Perspective

Lots of Hype. But, is it real?

Nano Business Environment

Hype v. Reality

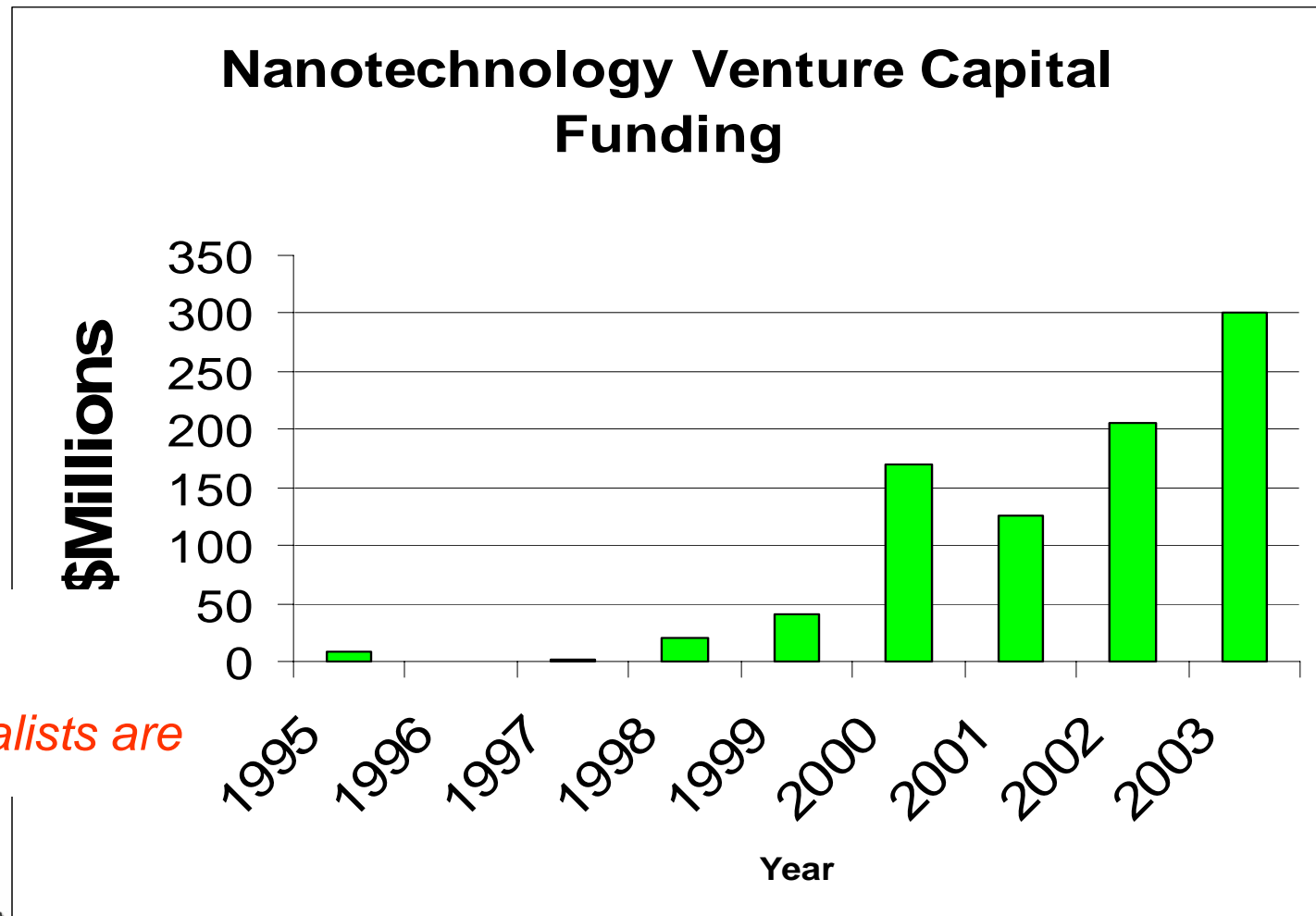


Perspective

The Science is Real.

Nano Business Environment

Hype v. Reality



Perspective

Venture capitalists are noticing.

Nano Business Environment

Hype v. Reality

Punk, Ziegel Nanotechnology Index

Altair Technologies Inc.	Nanomaterial Manufacturing
BioSante Pharmaceuticals, Inc.	Nanoparticulate-based vaccine adjuvant and delivery system
FEI Co.	Nano-profilometry (SNP) imaging systems.
Flamel Technologies, S.A.	Biopharmaceutical drug delivery systems
Harris & Harris Group, Inc.	Nanotech venture capital group
JMAR Technologies, Inc.	Plasma lithography at sub-100nm level
MFIC Corp.	Fluid materials processing systems
Nanogen, Inc.	NanoChip Molecular Biology Workstation
Nanophase Technologies, Corp.	Nanocrystalline materials
Nano-Proprietary Inc.	Carbon nanotube technology
NVE Corp.	Spintronics
Pharmacopia, Inc.	Drug discovery and chemical dev. processes
SkyePharm PLC	Integrated drug delivery
Symyx Technologies Inc.	Nanomaterial discovery
Veeco Instruments Inc.	Nanoman, PicoForce, Nanoscope

Perspective

Real products are emerging and Wall Street is noticing.

Nano Business Environment

The Role of Intellectual Property

51% Increase - Single day stock price increase after Nanogen, Inc. announced that it had received a “key” U.S. patent in the nanotech

Perspective
IP is a critical differentiator!

Nano Intellectual Property

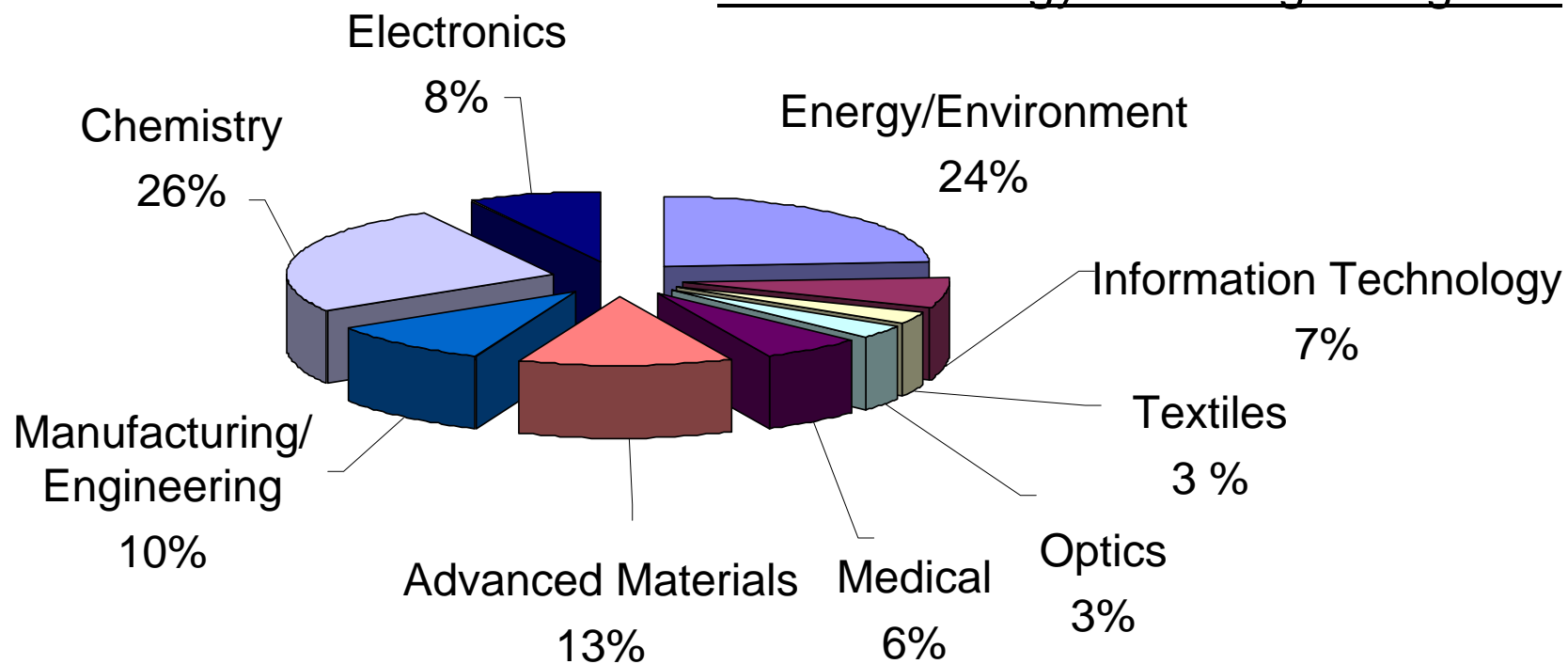
Where the Action Is

- Patent Application Prep and Prosecution
- Technology Transfer
 - Government Funding
 - University Spin Outs
- Licensing
- IP Strategy Development

Nano Intellectual Property

A View from the USPTO

Nanotechnology Patenting Categories



Source: U.S. Patent Office



Perspective

USPTO has its hands full.

Nano Intellectual Property

A View from the USPTO

- About 1500 Nano-related patents issued thru fall 2003
- Examiner education underway
- No new tech centers or classification planned
- **Many Classes Involved:** 57 (textiles derived from fullerenes), 106 (paint with nanoparticles that change colors), 204/422/435 (chemistry: electrical and wave energy/apparatus/molecular biology and microbiology), 257 (semiconductors), 423 (fullerenes), 428 (magnetic nanoparticles), 438 (molecular engines and computers), etc.

Perspective

Can the USPTO rise to the challenges?

Nano Intellectual Property

Preparation and Prosecution

- The Usual Suspects
 - Novelty - 35 U.S.C. 102
 - Obviousness - 35 U.S.C. 103
 - Enablement - 35 U.S.C. 112

Perspective

One patent law for all technologies.

Nano Intellectual Property

Preparation and Prosecution

- From USPTO Partnership Meeting, Issues the USPTO will focus on:
 - Inherency
 - Enablement
 - Predictability or lack thereof
 - Quantity of experimentation needed
 - Breadth of claims

Nano Intellectual Property

Obviousness

- Size probably does not matter, unless there is some unknown or unpredictable result
 - see, In Re Rose (Lumber case)
 - *but see*, In Re Hoeksema (Chemical case)

Nano Intellectual Property

Inherency

- With respect to the limitation in claim 14, the reference discloses that the device can detect with **submicron accuracy**. Although the reference **fails to disclose operating on the nanometer range**, the Examiner sees no difference in the Applicant's claimed invention and that provided by the reference which would create this significant difference in accuracy. Therefore, the **Examiner argues that the reference would have the ability to detect on the nanometer scale**.

Nano Intellectual Property

Breadth of Claims

1. A barcode comprising a collection of one or more particle size distributions of quantum dots having characteristic spectral emissions.

2. A composition comprising:
 - (a) a support;
 - (b) an item of interest, wherein said item of interest is attached to said support; and
 - (c) one or more particle size distributions of quantum dots having characteristic spectral emissions, wherein each of said quantum dots is associated with, attached to, or embedded within said support.

Nano Intellectual Property

Breadth of Claims

1. A nanowire, comprising:
 - (a) a first segment of a first material; and
 - (b) a second segment of a second material joined to said first segment; wherein at least one of said segments has a substantially uniform diameter of less than approximately 200 nm; and wherein said nanowire is selected from a population of nanowires having a substantially monodisperse distribution of nanowires.

4. A nanowire, comprising:
 - (a) a first segment of a first material; and
 - (b) a second segment of a second material joined to said first segment; said nanowire having at least one electronic property that varies as a function of diameter of said nanowire.

Nano Intellectual Property

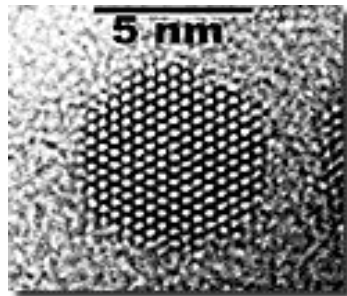
Patent Application Prep and Prosecution

- Does Small Make it Patentable?
- How Broad is Too Broad?
- Capturing Novelty Driven by Quantum Effects
- Preparing for Future Interferences
- Prophetic Inventing and Arm Waving
- Managing the Invention Disclosure Process

Perspective *Challenging considerations make work interesting, and provide significant opportunity to add value.*

Nano Intellectual Property

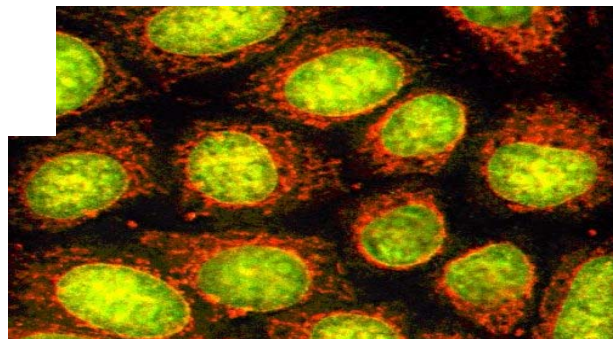
Patent Application Prep and Prosecution



5nm Quantum Dot
(viewed through a
transmission
electron
microscope)



Family of Qdot particles
excited with single
excitation source



Qdots used to label human
mitochondria cells

Perspective

*Same base
technology can lead
to many different
patentability
answers.*

Nano Intellectual Property

Licensing & Tech Transfer

- Impact of Government Funding
- University Licensing
 - field of use
 - term
 - future development
- Company to Company Licensing
 - same issues
 - others?

Nano Intellectual Property

Tech Transfer - Funding Source Encumbrances

- Statutes, regulations or contracts (policies) affect how IP is protected, used and transferred
 - Government
 - Academic institutions
 - Foundations
 - Industry
 - Venture capital
- Know these encumbrances and understand their impact on your IP strategy
 - Ownership - use “due diligence”

Nano Intellectual Property

Tech Transfer - Ownership

- Bayh-Dole Issues
 - Often affect ownership and exclusivity expectations
 - Almost all have IP ownership clauses that defer to university IP Policies, which may trump
 - Transfer of IP to company needs sponsor's approval
- Jointly developed IP – Who will own it?
 - May lose 35 USC § 103(c) protection

Nano Intellectual Property

General Themes

- Business Plan dictates licensing strategy
 - Pure Licensing Model
 - Manufacturing Model
 - Service Provider Model
- Don't get boxed-In by license
 - Uncertainties
 - Time to Develop
 - Field of Use
- Ongoing IP asset management is critical

Perspective

Effective Nano IP management can add tremendous shareholder value.

The End.

Disclaimers

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