

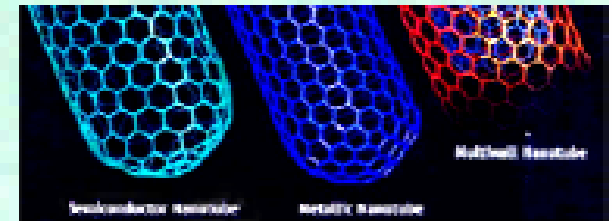
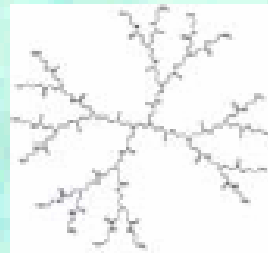
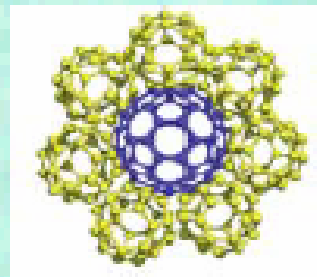
Nano Products

Dott. Perlo - CRF

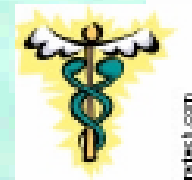
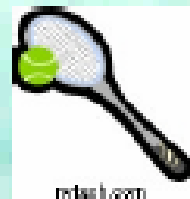
A convergence of different materials, technologies and industries

Keep in mind

Nanotechnology does not include just a single material or class of materials

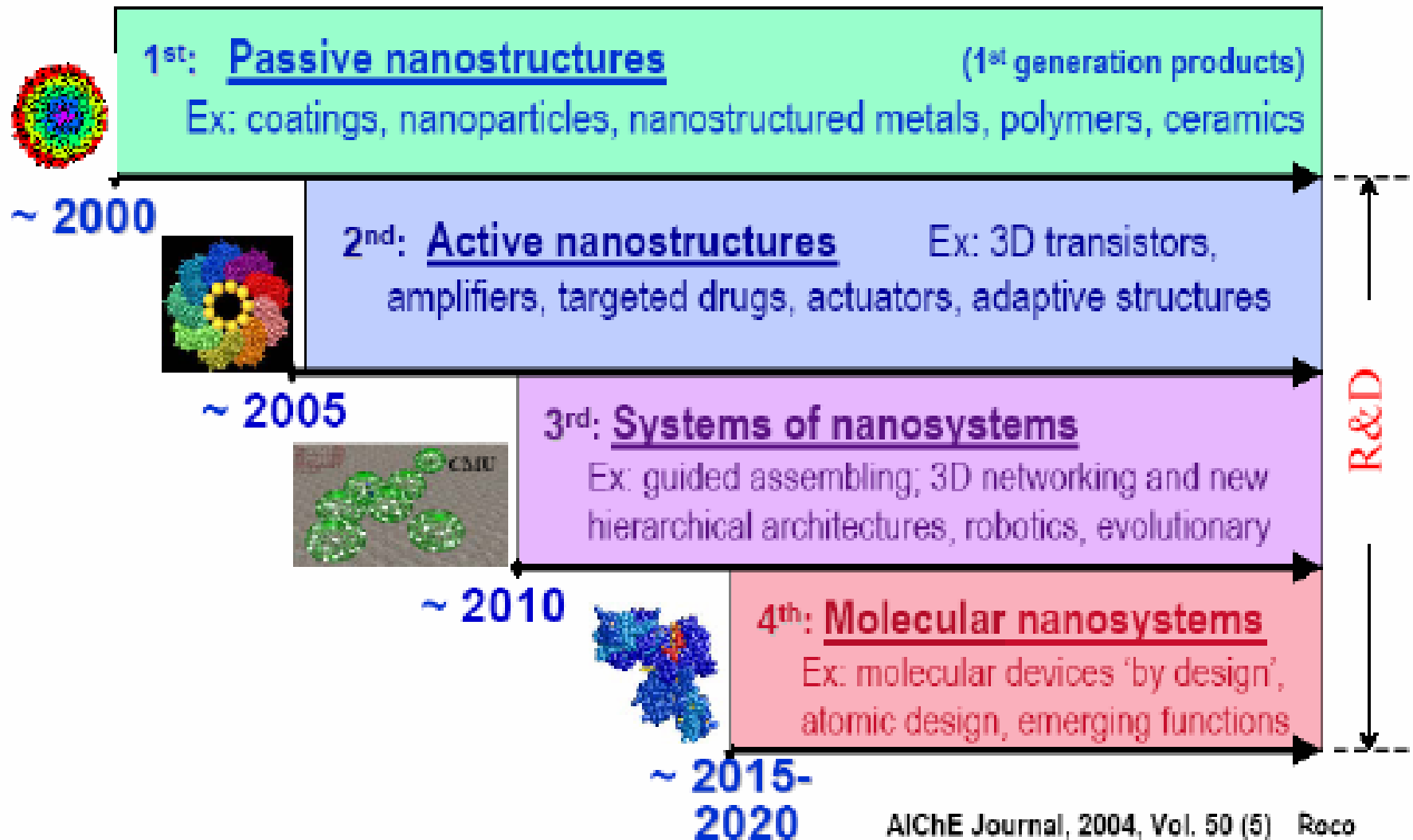


Nanotechnology does not include just a single industry or industrial sector

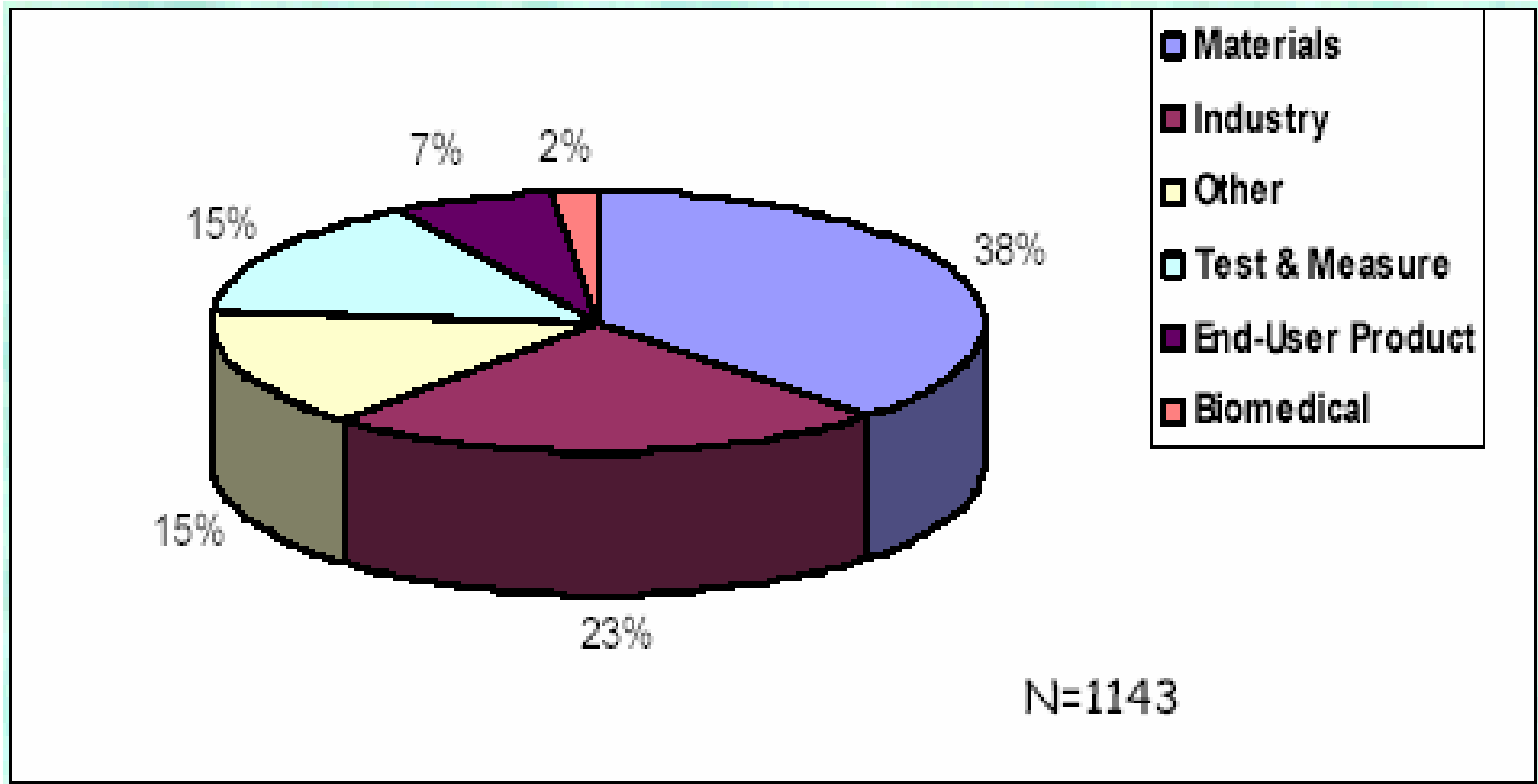


Nanotechnology converges with other technologies: biotechnology, information technology and cognitive science

Timeline for Nanotechnology



Nanoproducts Sept 2005



Taken From Barbara Karn

Sports Products

- **Tennis rackets**

“The Nanotube Power and VS Nanotube Drive lightweight, oversized-head models are made out of high modulus graphite with carbon nanotubes. . . One hundred times stronger than steel, yet one-sixth the weight, carbon nanotubes increase the rigidity of the stabilizers on each side of the racket's sweet spot. . . VS Nanotube rackets are five times more rigid than current carbon rackets and pack significantly more power.” [Business Week](#)



- **Tennis balls**

“Wilson Double Core tennis balls, with. . . InMat's Air D-Fense nanocomposite product inside, remain playable for four weeks. . . . InMat makes it harder for the air to escape by coating the ball's inner core with 20 microns thick of layered sheets of clay polymer nanocomposites--each 1 nanometer thin.” [Business Week](#)



- **NanoDynamics golf ball**

“This ball is engineered with nanoparticles to spin less, which should mean less slices and hooks. The bad news? Lower spin could mean shorter drives.” [Business Week](#)



- **Stronger golf clubs ...More accurate bowling balls**

Clothing Products

“In the clothing world, we have pants that repel water and won’t stain shirts and shoe inserts that keep you cool in the summer and warm in the winter, and nano socks that don’t “stink” due to the inclusion of nanotech materials (nanosized silver particles).

•Breathable waterproof ski jacket

“Nanotechnology makes the two-layer laminate windproof, waterproof, breathable and grime resistant--great for those bums who don't get around to washing their jackets until after the season. The result: a jacket with a long, functional life superior to coated jackets and competitive with Gore-Tex products.” [Forbes 2003](#)



•Wrinkle-resistant, stain-repellent threads

“Nano-Tex researchers attached molecular structures to cotton fibers, forming a barrier that causes liquids and stains to bead up on the surface and prevent absorption. Treated fabrics are not only wrinkle-proof but repel stains from perennial offenders like soda, coffee, wine, mayonnaise and syrup.” [Forbes 2003](#)



•Color-changing fabrics

Thread developed for military but may soon be used by clothing companies.

Cosmetics Products

- Skin care

“L’Oreal’s Plenitude line of cosmetics contains nanocapsules, which help active ingredients get to the skin’s deeper layers. The nanocapsules are also in L’Oreal’s higher brands such as Lancome.” [Small Times, 1 2004](#)

“Novasome” capsules can deeply penetrate skin and don’t degrade while on the shelf

- Nanocrystalline Sunscreen

“Its main ingredient is Z-COTE, a substance made with nanotechnology . . . Nano-dispersed zinc oxide. . . . Zinc oxide provides broad-spectrum protection against UVA and UVB rays, but its characteristic white pasty goop often leaves sunbathers and lifeguards feeling like they’re wearing clown makeup. The nanotechnology in Z-Cote produces a high-purity nanocrystalline zinc oxide, which allows the sunscreen to go on clear.” [Forbes 2003](#)



Products with Protective Coatings

- **Glare-reducing and fog-resistant coatings for eyeglasses and windshields**

- **Sunglasses**

“To give the glasses antireflection and scratch-resistance functionality, Nanofilm deposits coating layers of 150 nanor and 20 microns thick, respectively. Then it uses chemical self-assembly to form a polymer coating, three to ten nanometers thin, on the outer layer of the antireflective lenses. This not only seals and repels grime and skin oils but also makes the lenses more responsive.” [Forbes 2003](#)



- **High-Performance Ski Wax**

“Nanowax produces a hard, fast-gliding surface. The ultrathin coating lasts much longer than conventional waxing systems, while leaving the base free of buildup. And here's the "intelligent" part: Cerax Nanowax hardens as temperatures drop, adapting to the ski bases and snow crystals, so you can reach top speed from the first few feet on.” [Forbes 2003](#)



- **No-wax car finish**--for example, by Mercedes.

Health and Medicine

- Expanding ability to characterize genetic makeup will revolutionize the specificity of diagnostics and therapeutics
- Nanodevices can make gene/DNA sequencing more efficient
 - ‘Gene gun’ that uses nanoparticles to deliver genetic material to target cells
 - DNA microchip arrays using advances for IC industry
 - Semiconductor nanocrystals as fluorescent biological labels
- Effective and less expensive health care using remote and in-vivo devices
- New formulations and routes for drug delivery, optimal drug usage
 - “Liposomes. . . were developed to deliver anticancer therapeutics directly at tumors. Specifically, liposomal doxorubicin is being used to treat certain forms of cancer, while liposomal amphotericin B treats fungal infections often associated with aggressive anticancer treatments.”
- Cancer treatment
 - “Recently, a nanoparticulate formulation of the well-known anticancer compound taxol was submitted to the FDA as a new treatment for advanced-stage breast cancer.”

Health and Medicine

- More durable, rejection-resistant artificial tissues, muscles, bone
E.g. bionic eye, ear...: “synthetic orthopedic implants, like screws and plates, fabricated from nano-size particles of calcium and phosphate -- the materials that make up human bone. The material bonds with the natural bone and gradually becomes a part of it.”
- Sensors for early detection and prevention (“quantum dots”: “bits of semiconductor material a few thousand atoms wide, that will detect a variety of cancers and, perhaps, someday serve as “smart bombs” to destroy tumor cells”)
- STD prevention: “VivaGel is a topical microbicide gel product that has been developed for women as a preventative against the sexual transmission of HIV. It is also active in animal studies for the prevention of other sexually transmitted diseases including genital herpes and chlamydia.” (PR Newswire US, January 25, 2005)
- **IN THE WORKS:** thin films to measure blood-sugar levels
- **FUTURE:**
 - diabetic insulin biocapsules
 - pharmaceuticals utilizing “bucky ball” technology to selectively deliver drugs
 - cancer therapies using targeted radioactive biocapsules. [National Nanotechnology Infrastructure Network](#)
 - (“smart bombs” that destroy tumor cells), infections, clogged arteries, old age.

Health and Medicine Products

- LabNow Blood Analyser

“Tiny channels in a card filter white from red blood cells. When the card is popped into the analysing machine, it can come up with a white-cell count in 10 to 15 minutes. This could be important for HIV/Aids treatment.”
[Business Week](#)
- Bandages embedded with silver nanoparticles
- Drug delivery via a patch
- Thin films on implantations into the human body (for example screws, joints, and stents) allowing devices to last longer
- Respiration monitors that are many times more sensitive
- Man-made skin for skin graft applications.
[National Nanotechnology Infrastructure Network](#)

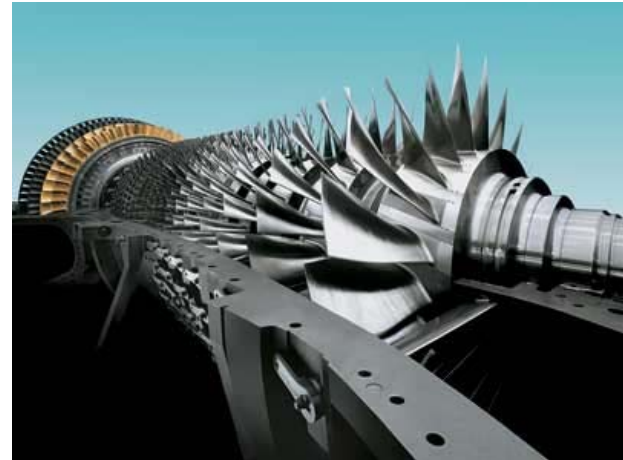


Energy and Environment

- Energy Production
 - Clean, less expensive sources enabled by novel nanomaterials and processes
 - Solar energy: Photovoltaic cells
 - Energy Utilization
 - High efficiency and durable home and industrial lighting
 - Solid state lighting can reduce total electricity consumption
 - Materials of construction sensing changing conditions and in response, altering their inner structure
- Environmental cleanup
 - Filters built out of carbon nanotubes, hollow cylinders only a few nanometers across, made of carbon atoms. Such fine sieves can filter bacteria and poliovirus particles out of drinking water.
- **IN THE WORKS:** Tiny cages of atoms to trap pollutants and chemical weapons in water and soil

Energy and Environment Products

- “[NanoBreeze Air Purifier](#) destroys all types of airborne contaminants. It attacks them on a molecular level using patented nanotechnology. ”
- GE Power Turbine
“Turbines are the workhorses of the digital age, providing both the juice to run our PCs, as well as the push to propel our jet planes. GE is exploring how nanotechnology can help to ruggedize the turbine blades used to spin these power plants. Using ceramics enriched with nanoscale particles, GE hopes to build more powerful turbines that operate at higher temperatures.” [Business Week](#)



Transportation

- Thermal barrier and wear resistant coatings
- High strength, light weight composites for increasing fuel efficiency
- High temperature sensors for under the hood
- Improved displays
- Battery technology
- Wear-resistant tires
- Automated highways

Which car uses nanocomposites ??

First car

- Up to 25 Kilometers per liter of gasoline
- Five stars on Safety
- Speed up to 200 Km/h

Second car

- Up to ..7 kilometers per liter of Gasoline
- Max three stars on safety
- Max Speed 150 Km/h



Which vehicle uses nanocomposites ??

First vehicle

- Up to 25 Kilometers per liter of fuel
- Five stars on Safety
- Speed up to 200 Km/h



Second vehicle

- "Up to" ..7 kilometers per liter of fuel
- Max four stars on safety
- Max Speed 150 Km/h



The winner is "Hummer H2 sport utility truck"

"Made with about seven pounds of nanocomposite material, the cargo bed Hummer's H2 SUT is lighter and more scratch proof than older plastics. Besides the weight advantage, GM says the nanocomposite parts don't change shape when exposed to temperature changes

Materials Manufacturing Products

- **Hummer H2 sport utility truck**

“Made with about seven pounds of nanocomposite material, the cargo bed Hummer’s H2 SUT is lighter and more scratch proof than older plastics. Besides the weight advantage, GM says the nanocomposite parts don’t change shape when exposed to temperature changes.”

[Business Week](#)



- **Self-cleaning concrete**

“An exterior view shows U.S. architect Richard Meier’s Jubilee Church, located in the Tor Tre Teste area of Rome, in this 2003 file photo. It is made of self-cleaning concrete that helps keep the surface shiny white.”

[The Associated Press, July 2005](#)



National Security

- Very high sensitivity, low power sensors for detecting chem/bio/nuclear threats
- Lightweight military platforms, without sacrificing functionality, safety and soldier security
 - Reduce fuel needs and logistical requirements
- Reduce carry-on weight of soldier gear
 - Increased functionality per unit weight

Space Exploration

- Advanced miniaturization, a key thrust area to enable new science and exploration missions
 - Ultrasmall sensors, power sources, communication, navigation, and propulsion systems with very low mass, volume and power consumption are needed
- Revolutions in electronics and computing will allow reconfigurable, autonomous, “thinking” spacecraft
- Nanotechnology presents a whole new spectrum of opportunities to build device components and systems for entirely new space architectures
 - Networks of ultrasmall probes on planetary surfaces
 - Micro-rovers that drive, hop, fly, and burrow
 - Collection of microspacecraft making a variety of measurements

Molecular Manufacturing

(products not yet developed)

- Self-replicating molecular assemblers: Devices that could, on their own, arrange atoms and molecules in precise ways for a specific purpose,” thus allowing us to “build almost anything that the laws of nature allow to exist.”
- “Mechanical surgeons” that could travel to trouble spots inside the body
- “Fresh food – ‘genuine meat, grain, vegetables, and so forth’ -- could be produced in the home.”
- “Suits made with nanotechnology could be used for virtual reality, simulating ‘most of the sights and sensations of an entire environment.’”
- “And nanotechnology could make some form of telepathy as possible as telephony.”
- “Nanomachines could precisely adjust your hair and skin color to your liking”
- “Wrinkles could be smoothed and excess fat removed”

Molecular Manufacturing

(products not yet developed)

- “Mold the face and body to whatever shape might be desired”
- “Respirocyte,” an artificial red blood cell capable of delivering oxygen hundreds of times more efficiently than real red blood cells, would be invaluable in the treatment of various respiratory and cardiovascular disorders, or as a substitute for real blood during transfusions. But they would also have “a variety of sports, veterinary, battlefield and other applications”; they could be used to boost a mountain climber's endurance, to help a diver hold his breath for hours, or to enable a soldier to fight harder.
- Nanomachines that repair cells and fix damaged DNA; to remove toxins, clean out cholesterol, and eliminate scar tissue; to destroy cancer cells and fight countless diseases
- “A person might intentionally put himself into stasis, perhaps to “time travel” dreamlessly into the future, or to wait out a centuries-long interstellar voyage.”
- “Mind-control systems, invisible and mobile eavesdropping devices, or unimaginably horrific tools of torture”

The Perfect Fridge?

Some products combine different kinds of nanotechnology, such as the Samsung Nano SilverSeal refrigerator

“Samsung has rolled out a line of fridges and washing machines that use nanocoatings to prevent nasty bugs from growing. Specks of silver, as small as one nanometer across, are used to coat surfaces. These nanoparticles are so electrically active that they inhibit the growth of harmful bacteria and fungi. In its fridge, Samsung used the nanosilver in the deodorizer unit and water dispenser to sanitize the air and water that passes over them.”

[Business Week](#)



Computing and Data Storage

- Processors with declining energy use and cost thus increasing efficiency of computers by one million.
- Small mass storage devices
- Integrated nanosensors: Collecting, processing and communicating massive amounts of data with minimal size, weight, and power consumption
- Higher transmission frequencies and more efficient utilization of optical spectrum to provide at least 10 times the bandwidth
- Quantum computing
- Display technologies: Flat-panel displays for TV and video screens that may one day be thinner than a sheet of paper

Electronics Products

- **Samsung 8 GB compact flash card**

“This flash memory unit boasts a fat 8 gigabytes of memory, room for loads of songs, photos and PowerPoint presentations.” [Business Week](#)



- **OLED digital camera**

“Organic light-emitting diodes (OLEDs) are much brighter than the liquid crystals (LCDs) used in many of today's flat-screen TVs and computer monitors. They boast a wider viewing angle than LCDs, which must be viewed head-on. OLEDs don't require backlighting as LCDs do, reducing power consumption.” [Forbes 2003](#)

