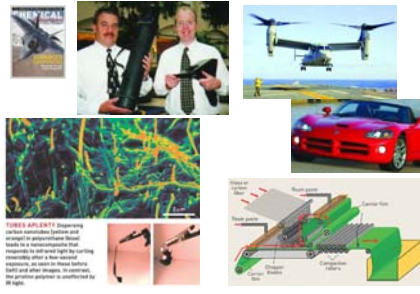


Polymers in Nanotechnology

NANOTECHNOLOGY FOR HIGH STRENGTH MATERIALS



TOUGH AND LIGHT Engineering carbon nanotubes (carbon and nitrogen) in polystyrene-based beads for a nanocomposite that promises to be used in everything from medical implants to bullet-resistant armor. The polymer is synthesized for light.

A Swimsuit Built for Speed

Speedo experimented with more than 60 types of fabric and performed hydrodynamic tests on some 400 elite swimmers to create one of the highest-tech swimsuits ever. The result is the LZR Racer. Made of high-density microfiber lined with polyurethane panels and coated with a water-repellent compound, it reduces drag more than any previous suit. How Speedo revolutionized a sport.

Speedo Market Share
75% Market Share in 2008

Hydrodynamics: The diagram shows the areas of greatest drag on a swimmer. The LZR Racer's design cuts down on the worst drag (in red).

Performance: When a swimmer gets tired, his stroke deteriorates, and he tends to plow through the water rather than glide on top. But the high-density fabric and strategically placed panels help the body to hold its shape and keep proper form.

LZR facts: To keep the outer surface of the suit smooth, the suit is made of only three pattern pieces and its seams are bonded rather than sewn. To do this, the pieces of fabric are laser-cut, then fused together, creating a flat seam.

KEY: More drag, Less drag



BETTER HEADGEAR THROUGH CHEMISTRY

Four more new ways to protect your channels.

1987 was a turning point. That's when a chemical called dihydroxy dimethyl ethylene urea (DMDHEU) showed a lot of promise. It's inexpensive and non-yellowing, but it's related to formaldehyde so there's that whole toxicity thing. Adding some chemical buffers and catalysts, however, made it safe.

Nano-Tex that's virtually stainproof. The fabric is soaked in a solution that contains gazillions of tiny particles, then heated to bond them to the fibers. The particles wrap themselves around the individual fibers of the khakis, with microscopic "whiskers" sticking out. These cause a barrier of air to form around the material, which prevents liquid from getting through. Because the whiskers are so small, they don't affect the feel of the fabric.

Biomimetics

Self-Cleaning Materials

THE LOTUS EFFECT

The lotus leaf's remarkable ability to repel dirt inspired development of self-cleaning materials.

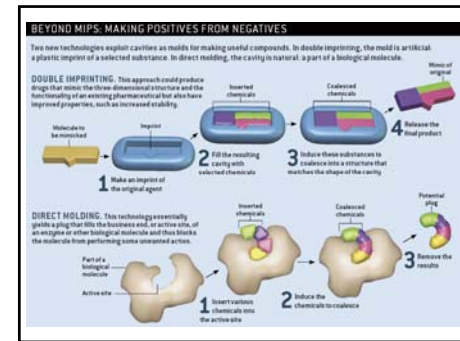
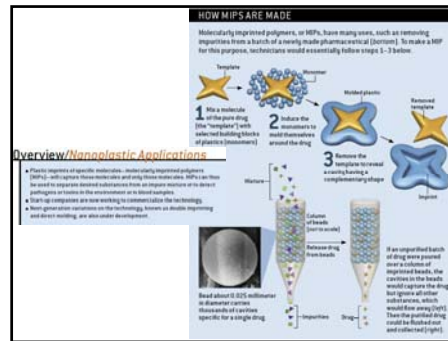
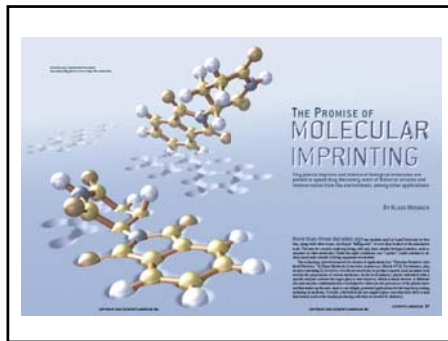
Water rolls across a leaf without sticking at all and carries dirt off.

Microscopic bumps on the surface cause air to stick off water droplets. A rough coating of microscopic wax crystals on the bumps further repels the dirt.

HOW THE LOTUS CLEANS ITSELF

Water droplets roll off the surface, picking up dirt and carrying it away. The water droplets leave behind a thin layer of wax crystals that repel the dirt.





A Wire For Spying On Cells
Nanotechnology: Tiny bioprobe features a field-effect transistor built from a kinked silicon nanowire
 Bethany Halford

The device's key component is a silicon nanowire that Lieber's team coaxed into growing with a kinked shape. In addition to controlling the nanowire's kinks, Lieber's lab can modulate the amounts of impurities in the silicon as it grows so that portions of the nanowire adopt metallike properties (*Nat. Nanotechnol.* 2009, 4, 824).

<http://pubs.acs.org/cen/news/88/433/8833now1.html>

Dendrimersomes Debut
Supramolecular Chemistry: Self-assembled dendrimer-based structures could deliver drugs, other substances
 Stu Borman

Nanostructure Dendrimersome cross-section shows its cell-membrane-like bilayer.

Janus dendrimers are amphiphilic, with nonpolar (red) and polar (blue) ends.

Dendrimersomes Micrographs show polygonal, cubic, spherical, tubular, rodlike, helical, and disklike dendrimersomes. Colored versions are shown in alternate rows.

<http://pubs.acs.org/cen/news/88/421/8821now1.html>

NANOSPINSPIRATIONS

By George M. Whitesides

The Once and Future Nanomachine

Biology outmatches futurists' most elaborate fantasies for molecular robots

The charm of the assembler is illusory: it is more appealing as metaphor than as reality, and less the solution of a problem than the hope for a miracle.

The Once and Future Nanomachine

A TALE OF TWO MOTORS

WHIRLING TAILS, found on many bacteria, are propelled by nanomotors. The tiny biochemical motor turns a rotary shaft that spins the tails, or flagella, and allows the bacteria, such as these *E. coli*, to move through liquid.

WHIRLING TAILS, made of metal, are propelled by nanomotors. The tiny biochemical motor turns a rotary shaft that spins the tails, or flagella, and allows the bacteria, such as these *E. coli*, to move through liquid.

80 SCIENTIFIC AMERICAN

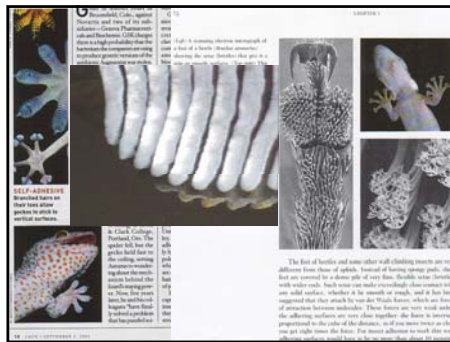
The Once and Future Nanomachine

TRIBOSOME reads along a strand of RNA (purple) to get instructions for stringing together the amino acids that constitute a protein [gold]. This assembly-line process brings to mind the robotic welders in an automotive factory [opposite page].

Table 15.1. A comparison of macroscale and biomolecular components and functions (from Drexler, 1981).

Device	Function	Molecular example(s)
Struts, beams, casings	Transmit force, hold positions	Microtubules, cellulose
Cables	Transmit tension	Collagen
Fasteners, glue	Connect parts	Intermolecular forces
Solenoids, actuators	Move things	Conformation-changing proteins, actin/myosin
Motors	Turn shafts	Flagellar motor
Drive shafts	Transmit torque	Bacterial flagella
Bearings	Support moving parts	Sigma bonds
Containers	Hold fluids	Vesicles
Pumps	Move fluids	Flagella, membrane proteins
Conveyor belts	Move components	RNA moved by fixed ribosomes (partial analogies)
Clamps	Hold workpieces	Enzymatic binding sites
Tools	Modify workpieces	Metallic complexes, functional groups
Production lines	Construct devices	Enzyme systems, ribosomes
Numerical control systems	Store and read programs	Genetic system

Nanosystems, K.E. Drexler, 1992

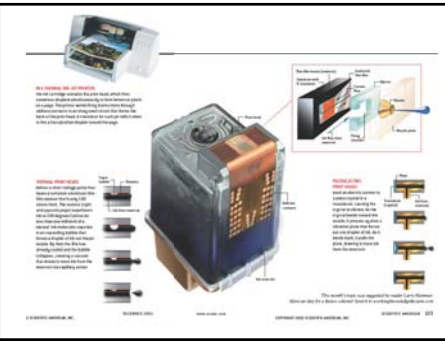
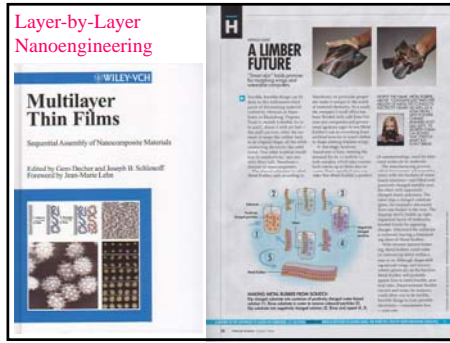
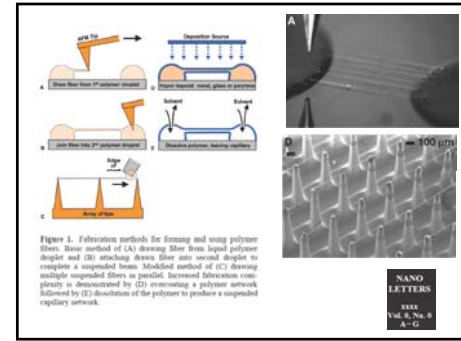
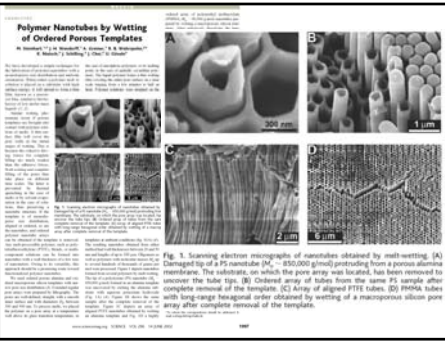
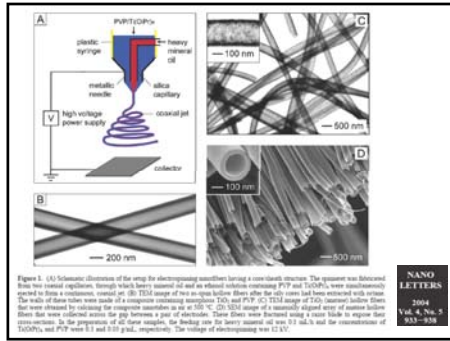


NANOTECHNOLOGY/NANOFABRICATION

Semiconductor industry.
 Higher resolution (100 nm resolution with 10 nm tolerance and 1 nm positioning accuracy).
 (Current resolution: 0.5 – 1.0 μm)

Next generation of lithographic methods
 Extremely high cost of lithographic machines
 Necessity for advanced resists (Smart materials)

Nonlithographic methods
 Self-assembly of individual molecules
 Organization & control at the molecular level
 Molecular electronics
 Computing in molecular length scales



NANOTECHNOLOGY FOR DRUG DELIVERY

The tiny tusk

Bull's-eye: Nanoparticles packed with targeting molecules (red) anchor to integrins (blue) on the outside of a tumor blood vessel cell before injecting mutant DNA (green) inside.

Overengineering

Nanotech Breakthrough: How 'Buckyosomes' Will Work

Fullerenes use antibodies as guidance systems to seek out and target specific cancer cells.

BUCKYBALL: Fullerenes are composed of 60 carbon atoms arranged in a spherical structure. At the opposite pole, they attach white, spider anchors.

SHEDDING TOGETHER: Doctors are the surgical with the anti-cancer antibodies on the outside and molecular structures that can easily bind with various chemical groups.

SUPERSTRUCTURE: Buckyballs are connected to antibodies and antibodies are connected to drugs. It is perfect for attack.

DRUG DELIVERY: The antibodies seek the buckyballs and attach to the protein receptors, the buckyballs release the drug.

78 NEWSWEEK JUNE 24, 2002

www.csixty.com

Good things in small packages

30 MODERN DRUG DISCOVERY JULY 2004

Nanotech drug delivery systems come in all shapes and sizes.

The Ups and Downs of Nanobiotech.

Balance is hard to find as researchers, investors, and environmentalists jockey for position.

Jeffrey M. Perkel
The Scientist
18 (16): 14-18, Aug. 30, 2004

Drug Development in The Future

Discovery of the DNA Structure (1953)

Revealing images: Franklin's photograph 51 of the B form of DNA told Watson and Crick that the molecule was a double helix.

On holiday, Franklin enjoyed several vacations in the Alps during the years she worked in Paris.

Pharmacogenetics & Pharmacogenomics

Pharmacogenetics is the study of genetic factors that influence response to drugs and predisposition to develop adverse effects. (The correlation of the DNA sequence of genes to a drug response)

Pharmacogenomics is the study of the pattern of expression of genes involved in a drug response in a defined environment. (The genetic factors determining the drug efficacy and toxicity)

Pharmacogenetics & Pharmacogenomics

Pharmacogenetics

Relationship between genetic variation and drug response (from the perspective of inherited and ethnic differences).

Pharmacogenomics

Relationship between genome and drug response or disease (from the perspective of non-inherited genetic traits (e.g., single nucleotide polymorphisms)).

DANGEROUS CHEMISTRY: A CONTRACT PRODUCTION NICHE

CHEMICAL & Engineering News

Pharmacogenomics

Genetic methods predict patient response and side effects

LAB CONSUMER

Making Medicin Personal

Pharmacogenomics drives development of customized drugs, but significant technical challenges remain.

According to a PricewaterhouseCoopers report, the total cost per approved drug (noted as average \$600 million (1) in 1997) (pharmacogenomics could) save drug manufacturers about \$20 million per compound.

