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ENVIRONMENTAL DEFENSE
finding the ways that work

Envestors UPDATE

Market solutions for environmental challenges

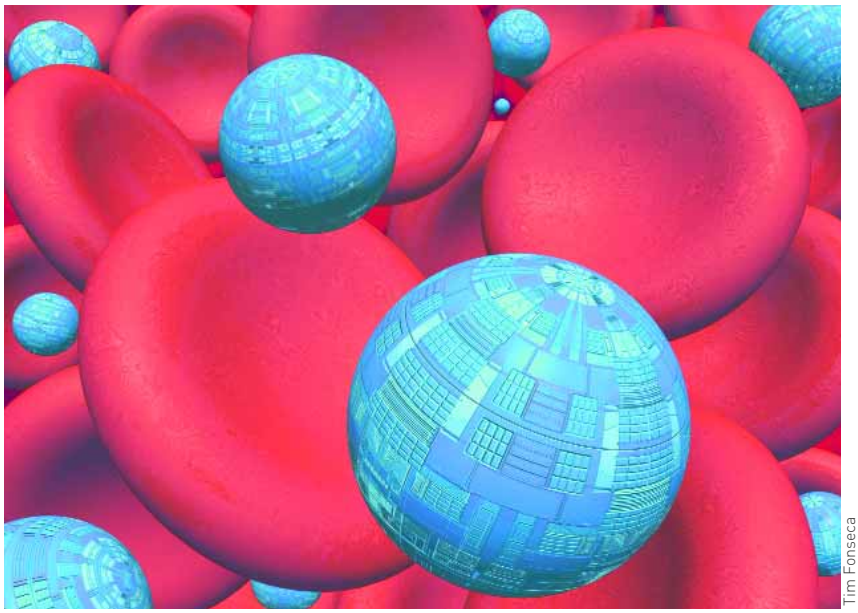
Nanotechnology: The invisible miracle

CAN WE REAP THE BENEFITS *AND* MANAGE THE RISKS?

IF YOU'VE PLAYED TENNIS, USED SUNSCREEN OR WORN DOCKERS LATELY, YOU MAY WELL HAVE HAD AN INTIMATE ENCOUNTER WITH A NANOWHISKER OR BUCKYBALL—human-engineered particles between 1 and 100 billionths of a meter in scale. With $13 billion of nanoproducts now on the market, *Forbes* has even begun compiling a top ten best products list: This year's includes a **Simmons HealthSmart** mattress impervious to sweat and dirt, **Maruman** golf clubs that drive farther, even a dental adhesive from **3M**.

The boom isn't slowing. Leading analyst **Lux Research** predicts that sales of nanotech products will rise from 0.1% of global manufacturing output today to 15% in 2014, totaling $2.6 trillion. By late 2004, venture capitalists had invested $1 billion in nanotech companies. The United States is the biggest player, putting up half of the $4 billion spent to date by corporations and investors globally and leading in nanotech patent applications (followed by Japan and China.) It's not just startups, though there are 1,200 of those; 19 of the 30 Dow Jones companies have also announced nanoinitiatives.

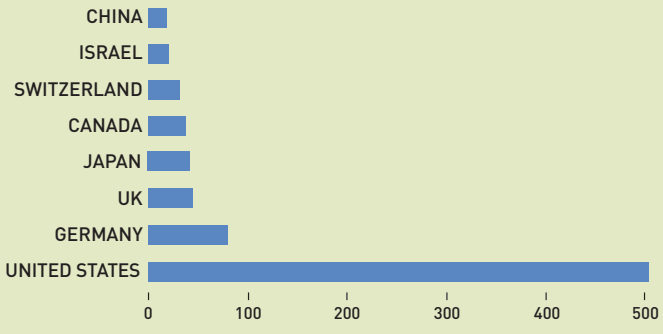
Nanotech is a transformational technology with potentially significant environmental benefits. **Nanosolar** of Palo Alto, which got initial funding from Google's founders, is moving into high-volume manufacturing of its low-cost thin-film solar panels. Massachusetts-based **Konarka**, which makes flexible photovoltaic plastic, won a multimillion-dollar Pentagon contract for tents that will generate their own electricity. To purify water, Connecticut's **KX Industries** is developing an antibacterial and antiviral filter; **Applied Nanotech** in Austin is working on a membrane for desalinating water without energy-intensive pressurization and **eMembrane** in Providence is developing nanoscale brushes to remove toxic metals. Nanolithography may reduce the use of hazardous chemicals in silicon-chip making, and new storage systems for food and drugs could improve health in the developing world.



Tim Fonseca

Tiny nanomachines known as "respirocytes" (artist's rendering) could one day operate as artificial red blood cells.

Where the action is . . .



IS IT SAFE?

But while inventors and investors go wild, a few important voices are raising a question: Are these revolutionary materials safe? Many of the world's largest insurers, including **Munich Re**, **Gen Re** and **Allianz**, have voiced alarm at lax efforts to assess and manage the risks of nanotechnology—a chorus joined, increasingly, by leading corporations. Neither group wants to repeat the asbestos experience, which S&P estimates may reach $200 billion in liability and

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Investigating the invisible

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Arthur Tilley/Getty Images

Nano from head to toe: Products with nanotechnology already on the U.S. market include golf clubs and golf balls, stain-resistant pants, sunscreen and sunglasses.

compensation costs. Nor do they want the kind of lic backlash that met genetically modified organisms, which has cost hundreds of millions in export losses. Already, signs of public nervousness are appearing. In June, *USA Today* ran a column headlined: "Scared of nano-pants? Maybe you're on to something," and protesters from a group called THONG (that's all they were wearing) gathered in front of a Chicago **Eddie Bauer** store to protest the company's use of nanofibers.

Nanomaterials often operate in the realm of quantum physics

The attributes that make nanomaterials valuable are also cause for concern.

and are valuable precisely because they behave in radically new ways. But these novel behaviors may also pose dangers, as the British Royal Society warned in its July 2004 report: "The very properties being exploited, such as high surface reactivity and the ability to cross cell membranes, might also have negative health and environmental impacts."

The studies done so far have not been reassuring: When researchers at NASA's Johnson Space Center introduced into the lungs of mice a dose of nanoparticles equivalent to what a worker could receive in 17 days under current federal dust limits (there are no nanoparticle-specific standards), the mice developed unusual lesions; researchers at the National Institute of Occupational Safety and Health reproduced those results and also found damage in the heart and aorta that can foreshadow atherosclerosis. A study at Southern Methodist University found that buckyballs damaged brain and liver cells in fish, and Georgia Tech researchers found that even at low concentrations they killed common soil bacteria crucial to ecosystem health.

Fundamental questions remain unanswered. Do nanoparticles persist and accumulate in the human body? If coatings are applied to reduce their toxicity, do those coatings degrade in the body or the environment? Do nanoparticles affect the immune system, cause cancer, impair fertility?

To date, limited public funds have gone to answering those questions. Though the U.S. government spends about $1 billion annually on nanoresearch and development, less than 4% goes to risk studies. Current regulations often draw no distinction between ordinary materials and their nano versions. For instance, at the nanoscale, titanium dioxide becomes a potent bacteriocide that could harm ecosystems. Yet because the FDA ruled it safe when applied to human skin, it is being used in sunscreen. No regulatory agency weighed in on its possible effects when washed off into oceans and streams.

A rough consensus is now emerging among insurers, national science academies, progressive companies and some public interest groups on what needs to be done. In its latest *Issues in Science and Technology*, the U.S. National Academy of Sciences asked Environmental Defense to present recommendations; these included allocating $100 million in federal funding for nano-risk research annually, updating regulatory regimes and developing corporate standards of care for workplace and product safety, including after disposal. Rapid action on all these fronts will protect investments and ensure that these small materials don't create big problems.

Hulton-Deutsch Collection/Corbis

Proud in their asbestos firefighting suits in 1941. Like nano, asbestos was once considered "the next big thing."

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From the pages of...

THE WALL STREET JOURNAL

Tuesday, June 14, 2005 (an abridged excerpt)

Let's get nanotech right

By Fred Krupp and Chad Holliday

We've seen many extravagant predictions surrounding this new world called nanotechnology. We've been here before. A new technology is heralded as the "next big thing." Companies are created. R&D budgets expand, and investors' eyes gleam at the prospect of new markets. Then two or 10 or 20 years later, when the technology is in widespread use, other effects become evident. There are many examples, including DDT and leaded gasoline, where we later learned of unintended consequences of initially promising technologies.

An early and open examination of the potential risks of a new product or technology is not just good common sense—it's good business strategy.

Industry, universities, government and public interest groups should collaborate to determine what testing is necessary for new nanoproducts. Businesses should conduct the needed testing before new products enter commercial use. A collaborative effort could set interim standards for nanotechnology around the world while regulations are under development.

At the same time, our government needs to invest more seriously in the research necessary to understand fully nanoparticle behavior. Lastly, both public and business interests will inevitably compel regulatory protection to ensure product safety and create a level playing field for business. Current regulations, designed for a world before nanotechnology, should be changed as needed to account for the novel properties of nanomaterials.

Can we reap the benefits while minimizing the risks? We believe we can. We encourage those with a stake in nanotechnology to collaborate in the development of responsible safety standards and to exercise great care in the launch of new materials.

Mr. Krupp is president of Environmental Defense.
Mr. Holliday is chairman and CEO of DuPont.

Organic wines: Choosing red, white or green

GREEN LIVING

More on green wines

Good wines made from organic grapes: Robert Sinskey Vineyards' 2002 Los Carneros Pinot Noir ($30): robertsinskey.com, 1-800-869-2030; and Bonterra Vineyards' 2001 Syrah ($24): www.winetasting.com/bonterravineyards, 1-800-846-8637.

Badger Mountain Vineyards offers USDA organic wines, including 2004 Johannisberg Riesling ($8): badgermtnvineyard.com, 1-800-643-9463.

Detailed information on labeling is available at: organicconsumers.org/Organic/OrganicWine.htm.

Organic wines have come a long way. In the 1970s many were considered just plain bad, but today's offerings compete with the world's top labels. Organics now make up 2 to 3% of the U.S. market, with much of the domestic growth in California. In Mendocino County's winemaking region, for example, 14% of the vineyards have switched to organic production, avoiding the use of conventional pesticides and synthetic fertilizers.

But all is not peaceful in Vineland. Some winemakers say USDA standards for labeling a wine organic are too strict. The requirement not to add sulfites, they say, makes it difficult to control fermentation, which is key to making a high-quality wine. "It's a real challenge to put out a consistent organic wine with a decent shelf life," says winemaker Charlie Rominger.

Instead of the USDA organic label, many wines, including imports, are labeled "made from organic grapes." These are farmed in a sustainable fashion: For instance, reduced tilling keeps nutrients in the soil and reduces runoff and erosion. They do typically contain added sulfites, which can trigger allergic reactions in 1 to 2% of the population, particularly asthmatics.

Here are some facts to help you decide what's right for your table.

• **USDA organic** To be labeled "organic," a wine must have 95% organic ingredients and no added sulfites. Although some great organic wines are made successfully without added sulfites (consider Chateau Lagarette, at $40 to $50 a bottle), there is a chance they will turn bad before a consumer can enjoy them.

• **Made from organic grapes.** To be labeled "made from organic grapes," a wine must contain 70% organic ingredients, and sulfites must be below 100 parts per million (ppm). If sulfites are above 10 ppm, a "contains sulfites" label is affixed.

By Jim Motavalli

Insuring the unknown

In a landmark 2004 report, Swiss Re, the world's largest reinsurer of life and health, urged its industry to "waste no time in assessing the risks and benefits" of nanotechnology.

Swiss Re

Trained in veterinary medicine, Annabelle Hett is in charge of Swiss Re's Risk Perception System, "SONAR."

"It is likely," the report concluded, "that humankind has never been exposed to such a variety of substances that can penetrate the human body apparently unhindered." Little understood in its potential for harm, nanotech may be a "revolutionary risk." Only insurer vigilance will avoid "an unforeseeable, ruinous loss accumulation unleashed by a flood of late claims." We spoke to the report's author, Annabelle Hett, risk specialist for Swiss Re's chief underwriting office.

Q *What resources has Swiss Re committed to nanotechnology?*

A We have experts evaluating nanotech risks within each sector—pharmaceuticals, automotive, electrochemical. We don't treat nanotech in general; it's so diverse that we have to go down to the application level and assess each and every product.

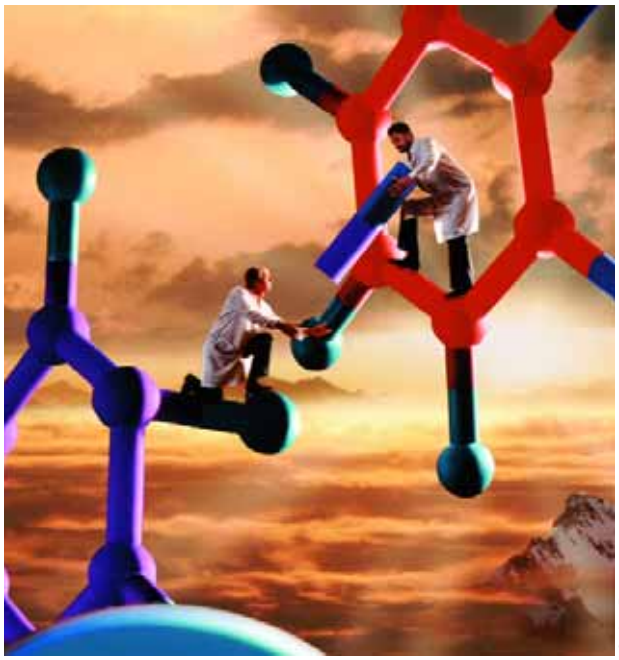
We also have an expert circle on emerging risks—underwriters, claims specialists, lawyers—who try to learn from past precedents. They look at technologies and materials that were global, mobile and present in many different industrial sectors and that had long-term, often latent, health and environmental effects. We're also developing ways to protect our own balance sheets, to set limits on coverage.

Swiss Re's April 2004 report: *Nanotechnology: Small Matter, Many Unknowns.*

Q *With all the unknowns, how are you writing policies?*

A Right now, we can look at exposure. We're concerned about anything that comes close to the human body or could impact the environment. But we also look at the whole product lifecycle. So while an aerosol with particles that can be breathed may seem riskier than nanotubes in a computer, recycling that computer might be an issue.

We also look at how a company deals with risk. You can manufacture explosives, but if you have state of the art management, you'll get a better rating than someone with less risky products but poor risk management. In nanotech, we can already begin to compare companies. For instance, working with nano-powders exposes workers more than working with liquids.



Swiss Re

Engineering the future, one atom at a time.

Q *Are there differences across the global market?*

A My key conclusion, after our nanotech conference last December [for business, scientists and regulators] was that the risk perceptions of different stakeholders differ big time. Europe is more conservative than the U.S. The UK is leading the world, having learned from many debates—mad-cow disease, gene technology—in which the public lost trust in their government. In the U.S., many feel they don't need precautions because everything goes through the courts and liability system. Asia is even less conservative.

Q *What are the biggest obstacles to sustainable development of nanotech?*

A We need governments to fund risk studies to quantify the probability and severity of losses; we need to know that testing and approval processes are correct. That's why we're supporting organizations like the International Council on Nanotechnology, which is working on a global regulatory framework.

We need all the stakeholders around the table, including groups like Environmental Defense: Because you are credible, you can help shape public perception. Billions of dollars a year are going into nanotech development; investors will only get a return if they study and manage the downside early on.