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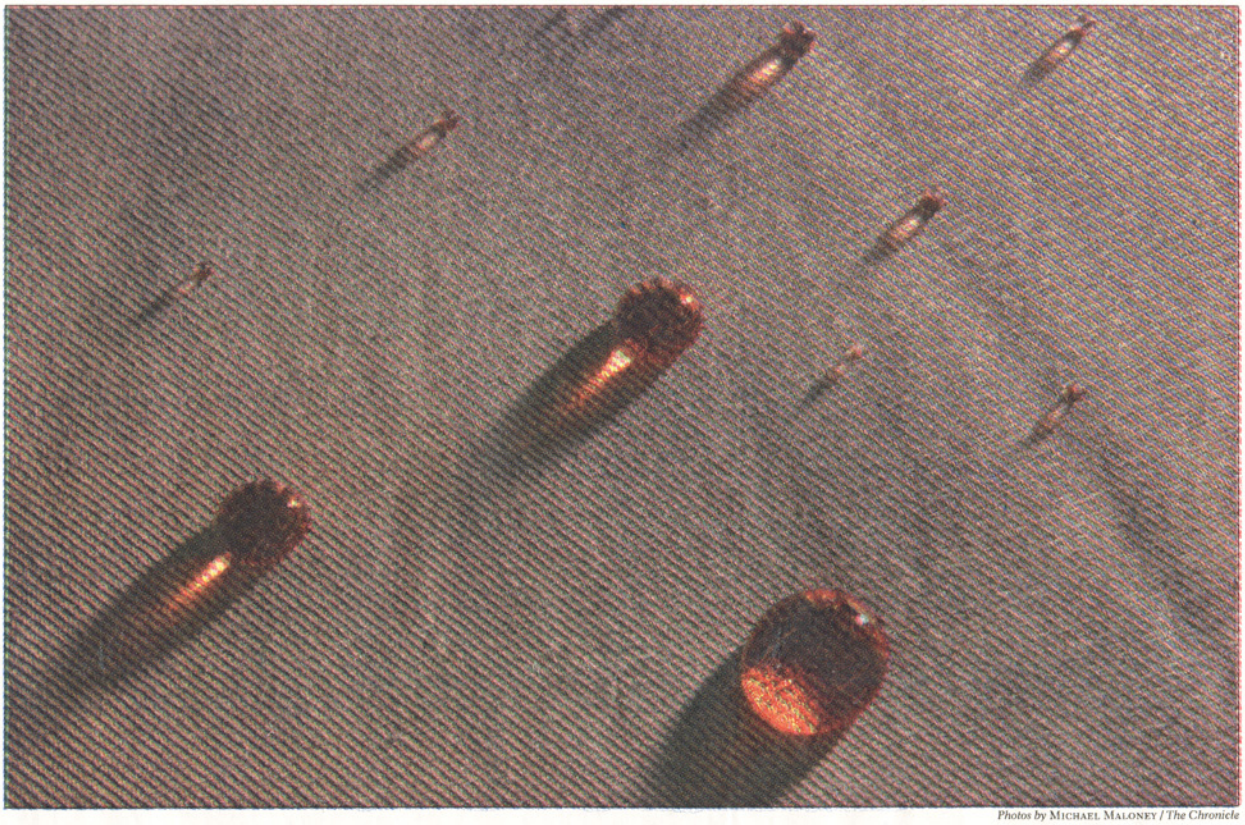

Photos by MICHAEL MALONEY / The Chronicle

Red Kool-Aid poured on cotton treated with a solution created by Nano-Tex of Emeryville beads up rather than soaking into the fabric and staining it.

Nanotech field no longer small

California already a leader in this emerging industry four years in a row

By Tom Abate
CHRONICLE STAFF WRITER

An Emeryville company called Nano-Tex has figured out how to coat fabrics with an ultrathin chemical shield that repels spills and stains.

At Lawrence Berkeley National Laboratory, construction crews are putting the finishing touches on a six-story research center that has been carved into the East Bay hills. The $85 million structure, called the Molecular Foundry, will soon house as many as 200 academic, industrial and government scientists who want to develop new ways to make tiny products.

The company and the laboratory represent two dimensions — one practical, the other theoretical — of the emerging field of nanotechnology. A nanometer is a billionth of a meter. A human hair is 50,000 to 100,000 nanometers thick. Nanotechnology is a realm of products thinner than 100 nanometers.

The National Science Foundation has estimated that nanotechnology could eventually employ more than a million Americans and change how we make everything from consumer goods to energy to electronics to medicines.

David Offord (right), Nano-Tex chief scientific officer, pours grape juice in the Nano-Tex-treated shirt pocket of Matt Hurwitz to show the product's efficiency.

INNOVATIONS
Part of a series exploring new developments in technology, business, science

California is already a leader in this tiny field of dreams. Candace Stuart, editor in chief of Small Times, a trade publication that tracks the industry, said the success of commercial firms like Nano-Tex, coupled with the opening of research centers like the Molecular Foundry, has made California the magazine's top-ranked nano-state four year in a row.

Nano-Tex chief scientific officer David Offord, 38, said his company — which employs 85 people — started almost by accident in 1998.

At the time, Offord was trying to develop an enzyme to dissolve oil spills. But the oil dissolved the enzyme before the en-

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California is leading the country in emerging nanotechnology field

▶ **NANO-TEX**
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zyme could do its work. So Offord, a chemist, tried to protect the enzyme by wrapping it inside a shell based on fluorine, a chemical used in nonstick frying pans, among other things.

The fluorine shell proved effective at repelling oil and water, but the oil cleanup application fell by the wayside. Instead, Offord got commercial backing to apply his technique to making spill-proof fabrics. By 2001, Nano-Tex had landed its first big commercial account, Eddie Bauer. Today, the privately held firm sells its chemical protection technique to nearly a hundred fabric mills.

As Offord explained it, the layer of nano-protection is added after the fabric has been woven into giant rolls. The woven material is unrolled, dunked into a chemical bath, pressed through rollers and then heated to bake the chemical into position. If the eye could see, the fabric would look like a series of thick parallel threads, each encircled by an almost immeasurably thin protective layer.

"Think of (each thread as) a redwood tree trunk," Offord said. "Our chemistry would be the moss growing around that tree trunk."

In order to make the water-resistant fabric washable, Offord used a chemical trick. Imagine that the "moss" is only repellent when it stands up straight. Offord designed a chemical "hinge" into the structure that makes the protective layer lie flat in the presence of soap. Once the garment has been cleaned, running it through a hot dryer or ironing the fabric supplies enough heat to reactivate the hinge and snap the protective layer back into stand-up position, he said.

"That's what nanotechnology is all about, making these very small structures do what you want them to do," Offord said.

Nano-Tex appears to be in the mainstream of consumer product development in the field, according to a survey unveiled Friday by the Project on Emerging Nanotechnologies at the Woodrow Wilson International Center for Scholars, a nonpartisan think-tank in Washington.

The Project said it found 212 consumer products advertised as containing nano-ingredients, a count that far exceeds the previous estimate of 80 consumer products put out by federal agencies that track nanotechnology. Stain- resistant shirts, pants and neckties were the largest single subcategory, making up 34 of the products listed. Sporting goods and cosmetics were the next most popular categories, including such products as suntan lotions that contain a nanothin layer of active ingredient so they don't leave a white film when they are applied.

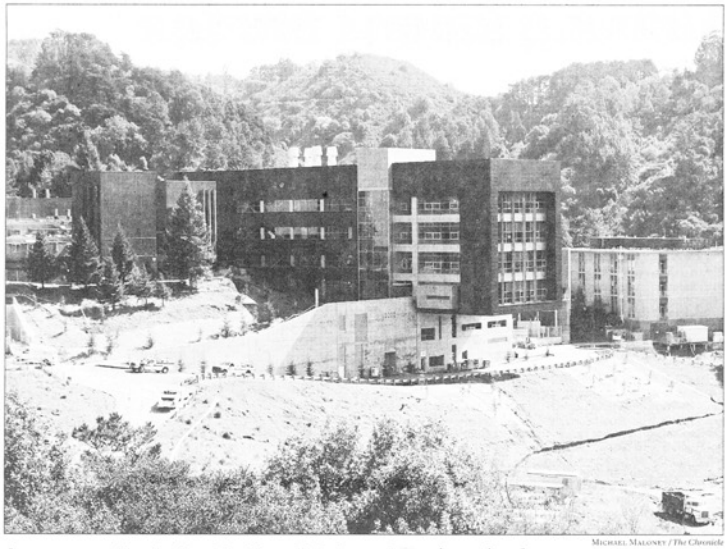
"This technology is already being incorporated into our daily lives. It's on store shelves and being sold in every part of the world," said David Rejeski, director of the Project, which also tracks the regulatory and safety dimensions of nanotechnology.

While the Project's inventory catalogs current consumer applications, the Molecular Foundry at Lawrence Berkeley Lab is designed to drive nanotechnology toward more-complex applications such as electronic circuits far smaller than those possible today, or molecular structures that would assemble themselves through processes as yet undiscovered.

On a tour of the new facility, UC Berkeley materials scientist Paul Alivisatos, who is also an associate director at Lawrence Berkeley Lab, likened nanotechnology to cooking in the sense that it is often more art than science.

"Growing crystals is a lot like trying to get your souffle to rise," said Alivisatos, who has been studying nanotech since 1986. "The recipe doesn't tell you everything you need to know."

Alivisatos said the Molecular Foundry will have two basic roles: making new discoveries on the one hand and also serving as school where visiting scientists can learn the tricks of the trade.



MICHAEL MALONEY / The Chronicle

Lawrence Berkeley National Laboratory is poised to open a six-story, $85 million research building dedicated to nanotechnology.

Molecular Foundry staffers are only now starting to move files and equipment into the 94,500-square-foot facility that was specifically engineered to study and manipulate supersmall particles. Several floors of the six-story structure were dug into the hillside, and it is on these lower, grounded levels that scientists will install imaging equipment so sensitive that even slight vibrations would distort the results.

The $85 million facility is one of five nanotech centers funded by the Department of Energy, which is the ultimate master of this laboratory overlooking the UC Berkeley campus. Alivisatos said he hopes the Molecular Foundry will become the center for futuristic research, dubbed the Helios Project, to create nanotech systems to mimic plants and convert sunlight into chemical fuels to reduce our dependence on gasoline.

"We would love someday to be able to make fuels using sunlight," he said.

As more attention is focused on nanotechnology, the Bay Area will compete with its traditional rivals for pre-eminence in the field. Jennifer Fonstad, a nanotech specialist with the Draper Fisher Jurvetson venture capital firm in Menlo Park, said Boston is a big center of nanotech innovation, as it was with high tech and biotech.

Austin, Texas, another Silicon Valley rival, is an emerging nanotech center. Seattle and Bethesda, Md., are strong competitors in the realm where biotech and nanotech intersect, she said.

Southern California is also developing expertise in the area, as exemplified by the creation last week of the Western Institute of Nanoelectronics, a research consortium headquartered at UCLA, but including scientists from Stanford, UC Berkeley and UC Santa Barbara, all focused on developing a new generation of electronics that consume less power.

Fonstad said California is a natural to develop environmentally friendly nanotechnologies. In the Bay Area, for instance, Fremont's Intematix Inc. is developing solid-state lighting systems that use nano-materials to deliver more brightness using less energy.

"California has always been a leader in clean technologies," Fonstad said, adding that using nanotechnology to reduce energy consumption or increase production will continue this tradition.

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