

FOCUS ON ENERGY: NANOTECH EXTRACTS BENEFITS FOR OIL INDUSTRY

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Aug. 11, 2004 - Nanotechnology might be a buzzword in many boardrooms or business plans, but some of its pioneering processes are old hat to the oil industry.

As those methods mature and others emerge, several petroleum players are exploring techniques to pump new life into their businesses.

Big oil companies such as Chevron-Texaco Corp. and ConocoPhillips Co. have dedicated resources to researching and developing micro and nanoscale technologies for exploration, production or refining. Their efforts include investing in or collaborating with startups, and establishing in-house business units.

"The energy world ... appears to be at the beginning of some kind of transition. Traditional resources are somewhat limited. We do concern ourselves with environmental impact, and looking at more efficient ways of delivering energy," said Bharat Chahar, director for advanced technology at ConocoPhillips.

The company, he added, continues to "keep an eye out on the development of nanotech" to help overcome those challenges.

Keeping an eye on commercial possibilities in part led to the creation of SouthWest NanoTechnologies, a spinout of ConocoPhillips and Oklahoma University. Norman, Okla.-based SouthWest used money from ConocoPhillips to construct a pilot plant to manufacture single-wall carbon nanotubes.

SouthWest's nanotubes take advantage of a mature method commonly used in chemical refining: catalysis, or acceleration of a chemical reaction by a substance. Expertise in catalytic methods led OU Professor Daniel Resasco and his research group to devise a way to produce high-quality nanotubes more rapidly and cheaply than other methods.

"People who are successful in tailoring (molecules) and not just making by chance a nanotube are those who know catalysis," said Resasco, SouthWest's chief scientific officer.

ConocoPhillips supports Resasco's catalysis work, but it's paying particular attention to SouthWest's nanotube advancements.

"When we made the investment, it was for strategic reasons," Chahar said. "We want to be able participate in carbon nanotubes' business development through our partnership."

Although SouthWest is marketing nanotubes to different industries, Chahar sees many potential applications within the oil industry. For instance, he said, nanotubes could be used to create lighter, stronger and more corrosion-resistant structural materials in platforms for offshore drilling.

Chahar said the focus on nanotubes also fits with his company's background in carbon materials. He said ConocoPhillips is the world's largest producer of carbon for electric arc furnace electrodes.

"Our carbon nanotube interest may be different from other oil companies because of our interest in the specialty carbon business. We look at carbon as a material. We have a lot of core competency in trying to produce higher value carbons."

ChevronTexaco also is no newcomer to nanoscale pursuits. The company, like many others in the industry, uses catalysts called zeolites – nanoporous crystalline materials – in the refining process to make fuels.

While catalysis has been part of the business for nearly a half century, advances in instrumentation have allowed scientists to image zeolites and understand interactions of the whole catalyst.

"You can look at them and try to perhaps adjust catalytic properties at the nanoscale using other components that go into these

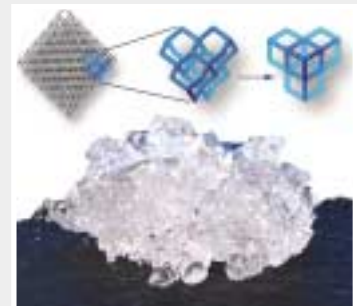


Image courtesy of Chevron USA Inc.

Chevron Texaco's higher diamondoids are a new series of carbon nanostructures that led to the creation of MolecularDiamond in 2002.

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catalysts," said Waqar Qureshi, who heads ChevronTexaco Technology Ventures' business unit, MolecularDiamond Technologies.

"Using other components that go into these catalysts increases control because you can see and measure better what you're doing."

One of those components could be higher diamondoids, a new series of carbon nanostructures discovered by ChevronTexaco scientists that led to the creation of MolecularDiamond in 2002.

The researchers, inspecting blocked pipes in natural gas wells, identified the clogging culprit: lower diamondoids, the smallest form of diamond. In the process, one of them noticed the higher diamondoid, a slightly larger form believed to exist but never before seen.

Molecular-Diamond is looking at using the higher diamondoids, which could create larger pore sizes to let more materials in, such as petroleum molecules. They also could be useful in the development of lubricants, such as motor oil.

Qureshi expects commercial uses to emerge within two years in polymer-based materials. Long-term, potential industries include optoelectronics, microprocessors and pharmaceuticals.

"If you look at nanotech and what's driven nanotech, to a great extent it's been new materials," Qureshi said. "What we're looking at is another series. ... These diamondoids could (bring) a significant return if we can develop a high-value application."

Oil companies also are interested in microscale methods to boost their business. Texas-based Input/Output Inc. announced in May it had launched the next generation of VectorSeis System Four, a MEMS-based product that provides seismic data for gas and oil exploration drilling and field development.

The system, originally launched in 2002, employs MEMS accelerometers that detect ground vibrations.

Cara Kiger, an Input/Output geophysicist and VectorSeis specialist, said the sensors provide more accurate and rapid data in a lighter package than traditional geophones. To help spread the word in what the company considers a risk-averse industry, it signed an agreement last year with Apache Corp., a U.S.-based independent oil and gas company.

"I think the micromachines are going to be key to the future for bringing us new efficiencies," Kiger said. "As a geophysicist, you tend to think of images and interpretations. ... But one of the things you have to think about is a cost-effective way of getting new information. One of the things MEMS technology is going to do is give us better information ... across the board."

Brian Valentine, program manager for the U.S. Department of Energy's office of industrial technologies, knows of several micro and nano-based approaches that could benefit the oil industry.

An agency-funded laboratory is developing a carbon nanotube-based drill pipe that is lighter, stronger and more flexible than steel. Valentine said researchers also are working on embedding an electrical wire and sensors in the carbon fiber resin.

New tools and technologies won't offer immunity from the trying and tedious work of oil exploration, production and refining, he said. But it's likely they will bring improvements to each step along the way.

"It will certainly enable the companies or technologies to operate more efficiently in a number of cases," he said. "In each case, there are examples of where nanotech will play a role in making each step more efficient."

Diamondoids could be nano's best friend

Microreactors could redefine chemistry, nanodrip by drop