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Team's Work Uses a Virus to Convert Methane to Ethylene

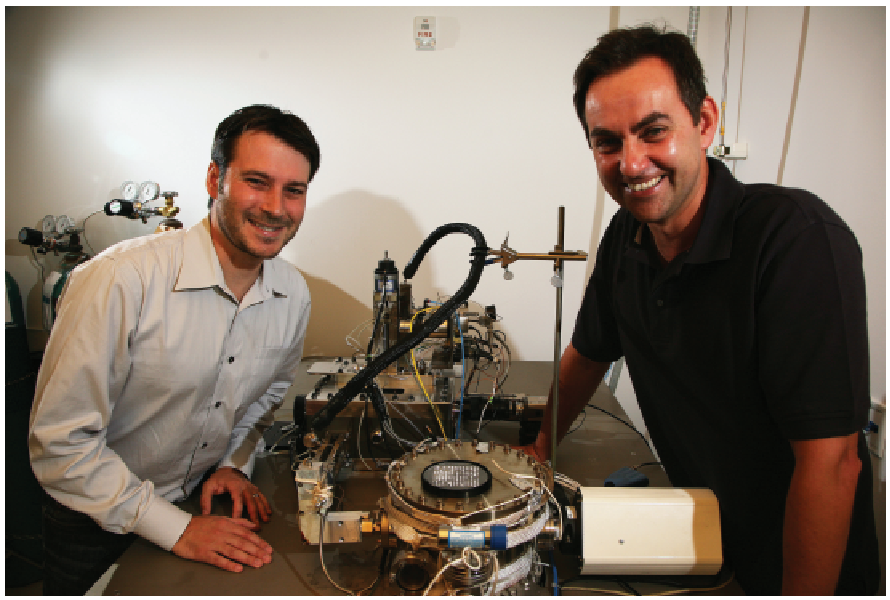
By JOHN MARKOFF

SAN FRANCISCO

A team of molecular biologists and materials scientists said Monday they had genetically engineered a virus to convert methane to ethylene more efficiently and at a significantly lower temperature than previously possible.

If they are successful in commercializing the new material, it will herald the arrival of a set of new technologies that represents a synthesis of molecular biology and industrial chemistry.

Ethylene, a gas with a characteristic sweet smell that may have once given insights to the Oracle of Delphi, is widely used in the manufacturing of plastics, solvents and fibers, and is essential for an array of consumer and industrial products. But it is still produced by steam cracking, a high-temperature, energy-intensive and expensive industrial process first developed in the 19th century. In this process, hydrocarbons found in crude oil are broken down into a range of simpler chemical compounds.



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CATALYSTS *Erik Scher, left, and Alex Tkachenko of Siluria Technologies reported progress in a nanoscience-based approach to ethylene production.*

The search for more efficient, less expensive approaches to the production of ethylene has gone on for more than three decades, and although some progress has been made no new techniques have yet proved commercially viable.

Now a small group of researchers at Siluria Technologies, a Silicon Valley startup based here, are reporting progress in commercializing a nanoscience-based approach to ethylene production.

Their technique for producing ethylene depends on the ability of a genetically engineered virus to coat itself with a metal that serves as a catalyst for an ethylene producing chemical reaction. The key is that the virus can create a "tangle of catalyst coated nanowires" — the researchers call it a hairball — that provide so much surface area for chemical reactions to occur that the energy needed to produce the reactions is much reduced.

The basic process, or chemical reaction, known as oxidative coupling of methane, was an area of intense research for the petrochemical industry beginning in the late 1980s. Researchers had some success but never achieved enough of an improvement in energy efficiency to justify displacing the traditional steam-cracking process.

With its hairballs of virus-created nanowires coated with unspecified metals, Siluria has been able to create ethylene-producing reactions at temperatures 200 to 300 degrees lower than previously achieved, said Erik Scher, a chemist who is one of the company's researchers. The company won't say specifically what the coating is, but say that magnesium oxide is an example of the kind of metals involved.

The work is based on a technique for genetically engineering viruses pioneered by Angela Belcher, who leads the Biomolecular Materials Group at M.I.T. The technique involves manipulating the genes of a virus, in this case one that usually attacks bacteria, so that it will collect and coat itself with inorganic materials, like metals and even carbon nanotubes.

The viruses can be used to create a dense tangle of metal nanowires, and the potential applications for these engineered materials are remarkably diverse. Dr. Belcher's lab is busy with research on more efficient batteries and solar cells, biofuels, hydrogen separation and other fuel cell technologies, CO2 sequestration, cancer diagnostic and therapeutic approaches, as well as an effort to create a catalyst that can convert ethanol to hydrogen at room temperature.

Last year the laboratory published a paper in the journal Science that described using a virus to synthesize nanowires of cobalt oxide at room temperature to improve the capacity of thin, flexible lithium ion batteries. In April the M.I.T. researchers engineered a virus to mimic photosynthesis and produce hydrogen at room temperature by separating water molecules.

Dr. Belcher said her goal had not been commercialization of the potential new technologies she had designed. "We think, 'What is the problem that needs to be solved?' and that is where we head," she said.

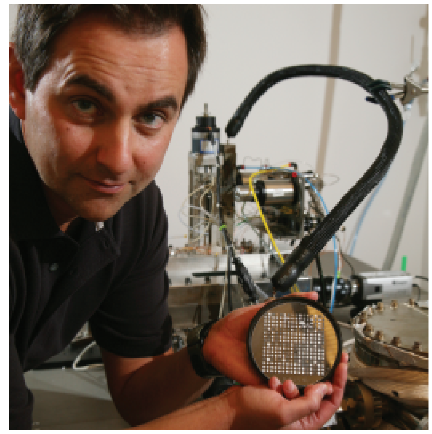
In contrast, the Siluria researchers said their advance in developing catalysts is the most significant step yet toward commercialization of the bacteriophage technique.

"We are learning from nature, but going to new places in the periodic table and working with the same tools and techniques to use materials that nature has not worked with," said Alex Tkachenko, a molecular biologist who is a co-founder of Siluria.

"What is different now," said Dr. Tkachenko, "is that Angie's biosynthetic technology allows us to grow these catalysts in a bottom-up synthetic way into novel shapes — nanowires — which in turn, allow us to create unique surface morphologies."

The researchers acknowledged that they do not yet have a complete scientific understanding of the surface behavior of their new catalyst.

"These are the next generations that will evolve into materials and systems, that we can't even imagine right now," said Mehmet Sarikaya, director of the Genetically Engineered Materials Science and Engineering Center at the University of Washington. Dr. Sarikaya's lab is performing similar research in designing materials like smaller proteins and peptides, that can mimic biological processes.



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