Researchers go nano, natural and green

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In 2002, U.S. farmers harvested 2.7 billion bushels of soybeans. Last year in Missouri, farmers harvested 194 million bushels of soybeans worth about $1.2 billion. Now, a team of researchers at the University of Missouri-Columbia is turning those soybeans into gold, with nothing more than a little water.

MU researchers Kattesh Katti, Raghuraman Kannan, and Kavita Katti led a team of scientists that have discovered how to make gold nanoparticles using gold salts, soybeans and water. No other chemicals are used in the process, which means this new process could have major environmental implications for the future.

“Typically, a producer must use a variety of synthetic or man-made chemicals to produce gold nanoparticles,” said Katti, professor of radiology and physics in MU’s School of Medicine, senior research scientist at MURR, and College of Arts and Science, and director of the University of Missouri Cancer Nanotechnology Platform. “In addition, to make the chemicals necessary for production, you need to have other artificial chemicals produced, creating an even larger, negative environmental impact. Our new process only takes what nature has made available to us and uses that to produce a technology that has already proven to have far-reaching impacts in technology and medicine.”

Gold nanoparticles are tiny pieces of gold, so small that they cannot be seen by the naked eye. Researchers believe that gold nanoparticles will be used in cancer detection and treatment and in the production of “smart” electronic devices in the computer and telecommunications industry. While the nanotechnology industry is expected to produce large quantities of nanoparticles in the near future, researchers have been worried about the environmental impact of the global nanotechnological revolution.

Since a variety of synthetic chemicals are needed to complete the formation of the gold nanoparticles, the MU research team turned to Mother Nature for assistance. They found that by submersing gold salts in water and then adding soybeans, gold nanoparticles were generated. The water pulls a phytochemical(s) out of the soybean that is effective in reducing the gold to nanoparticles. A second phytochemical(s) from the soybean, also pulled out by the water, then interacts with the nanoparticles to stabilize them and keep them from fusing with the particles nearby. This process creates nanoparticles that are uniform in size in a 100 percent green process.

“This fits with what we need to do for the future,” said Kannon, assistant professor of radiology. “We are solving a pollution problem at the very beginning stages of a developing technology. We don’t anticipate any waste or byproducts from this new process that would not be biodegradable. Every one of these compounds involved in the process already exists in nature.”

The new discovery has created a very large positive response in the scientific community. Researchers from as far away as Germany have been commenting on the discovery’s importance and the impact it will have in the future.

“Soy is grown worldwide and Dr. Katti’s Nobel Prize winning discovery will ensure that gold nanoparticles-based Nanomedicine products would be made available even to the less developed regions of the world,” said B. R. Barwale, 1998 winner of the world food prize and founder of Maharashtra Hybrid Seeds Company in India.

“Dr. Katti’s discovery sets up the beginning of a new knowledge frontier that interfaces plant science, chemistry and nanotechnology,” said Herbert W. Roesky, a professor and world renowned chemist from the University of Goettingen in Germany.

Katti, Kannan, Henry White, MU professor of physics, and Kavita Katti, a senior research chemist, have filed a patent for the new process and developed a new company, Greennano Company, which focuses on development, commercialization and world wide supply of green nanoparticles for medical and technological applications.

The research team includes Kattesh and Kavita Katti, Kannan, post-doctoral scientists Satish Nune and Nripin Chanda, and Mizzou graduate student Swapna Mekapothula. The research was funded by grants from the National Cancer Institute. Katti recently presented the work at the annual National Cancer Institute Alliance for Nanotechnology in Cancer Investigator’s meeting in October. He also will be presenting the research at the Fourth International Congress of Nanotechnology and the Clean Tech World Congress held in San Francisco in early November.

“Dr. Katti’s novel methodology to develop gold nanoparticles with soy will have important implications as the field of nanotechnology blossoms and has greater needs for ‘green’ synthesis of gold based nanoparticles. It is a very important first step,” said Sam Gambhir, director of the Center for Cancer Nanotechnology Excellence at Stanford University.

The discovery also could open doors for additional medical fields, as some of the chemicals used to make nanoparticles are toxic to humans. Having a 100 percent natural process could allow medical researchers to expand the use of the nanoparticles.

“Dr. Katti's discovery of green and non-toxic gold nanoparticles is a significant step to help alleviate the pain and suffering of patients with

Pseudoxanthoma elasticum (PXE)," said Frances Bernham, president of the National Association of Pseudoxanthoma elasticum. PXE causes changes in the retina of the eye that results in significant loss of central vision.

"The application of soy for the production of gold nanoparticles is amazing," said Puspendu Das, physical chemistry professor at the Indian Institute of Science Bangalore. "It shows for the first time that chemicals within soy are capable of producing gold nanoparticles. This clearly marks the beginning of a new field of 'Phytochemical-Nanoscience' and opens up a new pathway for discoveries in nanotechnology. This invention will have far-reaching implications in nanoscience and technology research globally since nanoparticles of gold are used in almost every sensor design and are implicated in life sciences for diagnostic and therapeutic applications."

Source: University of Missouri-Columbia

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