Small solutions to BIG problems

BY KIMBERLY PARSLEY

ENVIRONMENTAL ISSUES HAVE LONG BEEN CLOSE TO DR. TINGYING ZENG'S HEART. AN ASSISTANT PROFESSOR OF CHEMISTRY, SHE HAS A PARTICULAR INTEREST IN WANTING TO FIND SOLUTIONS TO POLLUTION PROBLEMS. WITH THE HELP OF A SMALL GROUP OF UNDERGRADUATE STUDENTS AND EVEN SMALLER MATERIALS, DR. ZENG'S RESEARCH COULD OFFER A BIG BREAK IN FINDING JUST SUCH A SOLUTION.

"We use nanotechnology to generate nanomaterials. We characterize, or determine the properties of, these nanomaterials for different types of applications," said Zeng. Nanotechnology involves research and technology development at the atomic, molecular, or macromolecular levels in the dimension range of approximately one to one hundred nanometers (one nanometer is one billionth of a meter).

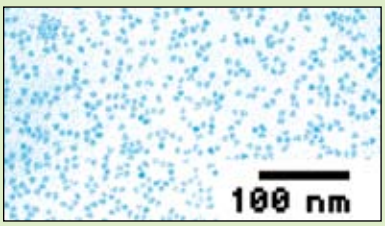
One application involves using nanotechnology to manufacture a new type of nanomaterial to efficiently capture mercury in flue gases that result from coal-fired power plants — a project of particular interest to the Commonwealth of Kentucky, the U.S. Environmental Protection Agency, and the U.S. Department of Energy. Dr. Zeng works with another WKU scientist, Dr. Wei-Ping Pan, on mercury removal efficiency evaluation of the nanomaterials.

Another application is creating a nanomaterial that will function as a sunlight harvester to absorb sunlight to generate electricity. In effect, this would be a nanoscale solar cell that would harvest sunlight (photon energy) and convert it to electricity (electron energy), Zeng said. "We want to generate a green power supply involving nanotechnology in energy conversion." Green power is a term used to describe environmentally friendly power.

A third project on which Zeng and her students are working involves using Nano crystals for wastewater treatment. "We use these nano crystals to absorb sunlight to decompose the organic molecules in resident wastewater."

Green power supply is our future direction for electricity

Zeng and her students use chemical methodology plus nanotechnology to produce the nanomaterials for the projects. Her students' assistance is critical to the success of the research. "I am very glad that the students can learn about and be extensively engaged in research involving nanotechnology and nanomaterials. That will help them with career development," Zeng said.



Nano crystal at a 100 nanometer scale

This cutting edge research drew interest from Oak Ridge National Laboratory, where Dr. Zeng and one of her students, Cassie Norris, spent several weeks during the summer of 2005. Zeng, supported by a WKU Summer Faculty Scholarship, was in the laser spectroscopy group (which studies material interaction with light), while Norris, supported by the WKU Materials Characterization Center, was in the catalyst group (which works with materials that change a chemical reaction rate). Zeng said the time at Oak Ridge was an excellent experience for both herself and Norris due to the exposure to other scientists, technologies, and instruments. She said that the collaboration with Oak Ridge would continue in the future, providing more opportunities for students. "The students will have the opportunity to be extensively exposed to the advanced instrumentation environment and the scientific research environment."

"Currently, our research is focusing on new generation solar cells," Zeng said. For example, in combination with the nanomaterials as sunlight harvesters, she used the dye from blackberries because it is effective, easy to obtain, and inexpensive. "That means we can use a very cheap natural dye to generate electricity. Blackberry juice costs about three dollars per pint, whereas the synthesized dye sells for more than $200 per

Dr. Tingying Zeng

fifty milligrams and is highly toxic," she explained.

"I really believe that within five to ten years, this type of new generation solar cell will be on the market," Zeng said, and she hopes her research will help make that happen. According to Zeng, the solar cell currently being marketed uses a silicon material and is very expensive to produce. The cost-prohibitive nature of the cell keeps it from being widely used. In addition, the cell now available on the market requires precise conditions to produce and is easily rendered less efficient by dust and impurities.

"That's why we focus on the new generation solar cell. This type of solar cell processed by nanotechnology uses only nanomaterial. We believe nanomaterial significantly improves the efficiency, and using a natural dye, such as that produced by the blackberry, will significantly decrease the cost," she said.

Dr. Zeng further explained that there are certainly technical difficulties to overcome, and she and her students are working on those in the lab. They are working toward optimizing the material to generate a high efficiency solar cell that can reach over eight percent efficiency. "Once the efficiency reaches over eight percent, we can think about marketing the solar cell, which can be produced in large scale in the industry to partially replace those expensive silicon solar cells first, and gradually can compete with the traditional solar cell."

Zeng believes that by using natural sunlight as a green power supply source, cars, airplanes, and other vehicles being powered by solar cells will be possible in the not too distant future. Also, this technology can be easily developed to generate hydrogen from water to supply non-carbon fuel for fuel cells that are another type of green power supply approach.

Harnessing the sunlight and using it as a green power source could solve other problems of modern life as well, such as the high cost of heating with natural gas, running our cars with expensive gases, and lighting our houses using electricity from coal-fired power plants as examples.

Zeng, who began her research career at Tsinghua University and Beijing University of Chemical Technology in China, and then continued at Virginia Tech in the United States, said her research would not be possible without the help of her students and the support of Western's administration and internal grants program, as well as the Materials Characterization Center at WKU.

"Green power supply is our future direction for electricity," Zeng said. "I love sunlight and this green power supply program." ■