Science of the small offers big diversity

BY LAURA MILLSAPS

TO THE CASUAL OBSERVER, THE SCIENCE OF DEVELOPING mesoporous nanoparticles would seem to be a narrowly focused, even esoteric area of chemistry.

But to Igor Slowing, a scientist for Ames Laboratory since 2009, the research is a jumping off place for a wide range of scientific disciplines, and that's the attraction.

"These particles are really a means of accomplishing many different things—they are a platform we can modify or adapt to do anything, from making fuels to delivering medicines to cleaning the environment to things like creating specialized lenses. These structures give me many opportunities to learn more about other areas of science, and that is really exciting to me."

Pursuing a wide range of interests has always been important to Slowing, who taught organic chemistry at three different universities, published books of short stories, and operated a theater company in his native Guatemala before coming to Iowa State University to pursue his Ph.D. studies.

He completed his Ph.D. in 2008 and post-doctoral work with the late Victor Shang-Yi Lin, researching the use of nanoparticles for intracellular drug delivery.

Now, Slowing and fellow Ames lab researchers have successfully developed a biofuel refining technique using mesostructured nanoparticles that combine two processes—sequestering free fatty acids and catalyzing the conversion to green diesel.

Pursuing the use of nanoparticles as catalysts for renewable fuels presents big challenges, says Slowing, as well as big advantages.

"There's such a big diversity of renewable resources. For each resource, whether it's grass or microalgae or orange peels, the technology must be adapted to best process it. This can be a difficult thing," Slowing explains. "But the advantage is this: if we can develop smart, clean, economical processes that are specific to each material, these biorenewable resources can then be used not only for fuel, but also as sources for other things like pharmaceutical components. In that way, we can exploit the benefits of each of these resources fully."

In another project, Slowing is also working to develop nanoparticles that can be used as a substitute catalyst in place of chromium, used in the processing of hydrocarbons but is also an environmental contaminant and carcinogen.

And in a different application, Slowing will be partnering with a researcher from Mississippi State University in a project to develop nanomaterials that can absorb nuclear waste contamination in the environment.

It is a far cry from the technology's origins. With the increasing complexity and capabilities of these particles, they have gotten larger, Slowing says, and are more properly categorized in the mesoscale, or structures larger than 100 nanometers. Because the chemical and physical properties of nanoscale materials differ from the bulk properties of the same material and are the key to their amazing potential, these mid-range or mesodomain materials may hold even more surprises.

"These can act as a bridge between the macro- and nano-world, and we don't know a lot right now about what other properties may emerge. It's one of the great questions I have for future research, and that I look forward to tackling," says Slowing. "Throughout history, it has been the understanding of these properties and how to control them that has been missing," Slowing adds. "As we gain better understanding, the possibilities for their application will continue to expand."

Academic Family Tree:

Slowing also conducts research in an area unrelated to nanoparticles: he keeps an academic genealogy tree on the wall of his office—with names, dates, and pictures.

With pages hanging in a line reaching to the ceiling, Slowing can trace his academic heritage starting with his own doctoral research at Iowa State. From there, his academic heritage goes back on this office wall a few hundred years. It includes scientists who were history books unto themselves, like Benjamin Rush, a signer of the Declaration of Independence and a physician; or Justus von Liebig, a 19th century German chemist and inventor.

"I've always loved history in general and the history of science in particular," says Slowing. "When I began to study chemistry, I was curious to know how I was related to these people that I was reading about."

And Slowing's historical research enabled him to trace his academic genealogy over 600 years, to the flowering of scientific thought that occurred in Western Europe.

Slowing says he'd like to learn more about the scientists in his family tree that are still alive and actively researching. Among them is Harry Gray, a pioneering bioinorganic chemist at the California Institute of Technology whose work Slowing finds fascinating.

"These are scientists actively working in areas very different from mine, and yet their accomplishments keep inspiring my work. The influence of ideas across the years and across scientific disciplines is a great history lesson."