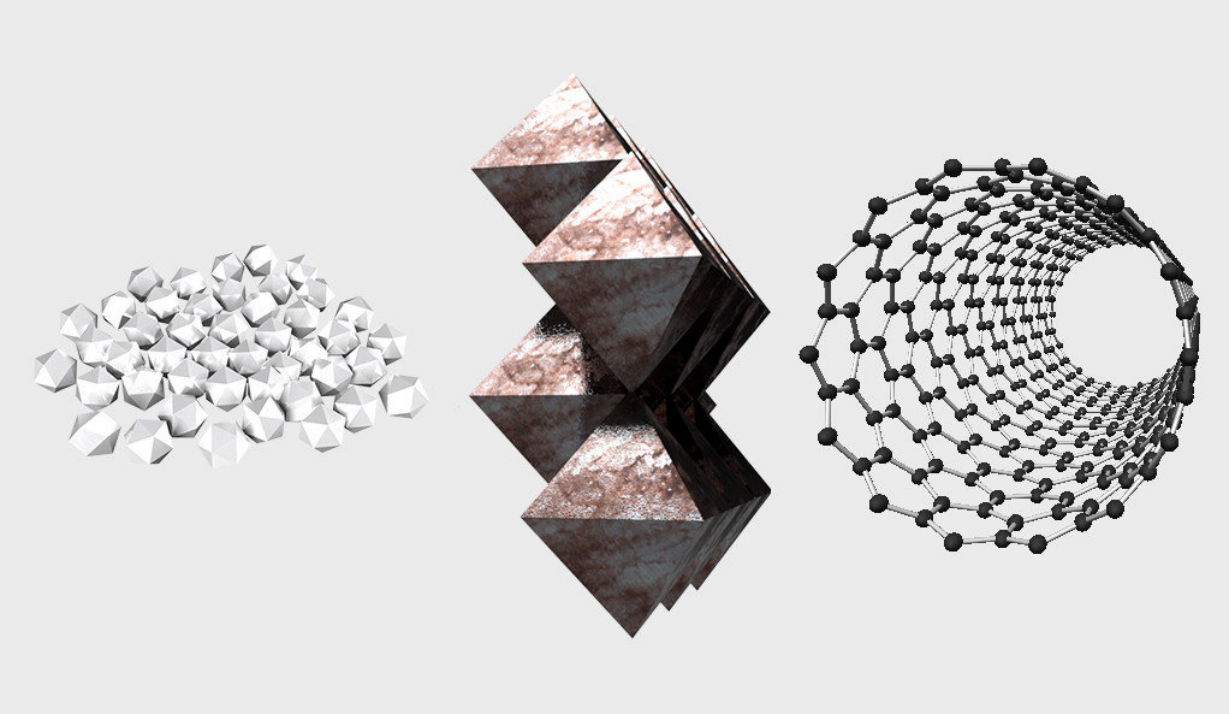
A reimagined future for sustainable nanomaterials

May 1 2018, by William Weir



Researchers propose a new method for nanomaterial selection that incorporates environmental and functional performance, as well as cost. Credit: Steve Geringer

Engineered nanomaterials hold great promise for medicine, electronics, water treatment, and other fields. But when the materials are designed without critical information about environmental impacts at the start of

the process, their long-term effects could undermine those advances. A Yale-led team of researchers hopes to change that.

In a study published April 30 in *Nature Nanotechnology*, Yale researchers outline a strategy to give materials designers the tools they need to make the necessary assessments efficiently and at the beginning of the design process.

Engineers traditionally focus on the function and cost of their products. Without the information to consider long-term environmental impacts, though, it is difficult to predict adverse effects, said the researchers, and that lack of information means unintended consequences often go unnoticed until long after the product has been commercialized. This can lead to hastily replacing the material with another that proves to have equally bad, or even worse, effects, they note, adding that having materials property information at the start of the design process could change that pattern.

"As a researcher, if I have limited resources for research and development, I don't want to spend it on something that's not going to be viable due to its effects on human health," said Julie Zimmerman, professor of chemical & environmental engineering and co-senior author of the study. "I want to know now, before I develop that product."

To that end, the researchers have developed a database that serves as a screening tool for environmentally sustainable material selection. It's a chart that lists nanomaterials and assesses each for properties such as size, shape, and such performance characteristics as toxicity and antimicrobial activity. Mark Falinski, a Ph.D. student and lead author of the study, said this information would allow researchers to weigh the different effects of the material before actually developing it.

"For instance, if I want to make a good antimicrobial silver nanoparticle

and I want it to require the least amount of energy possible to make it, I could look at this materials selection strategy," he said.

The database is also designed to allow researchers to enter their data and make the chart more robust. The researchers said the project is a call to action to both environmental and materials researchers to develop the data needed to aid sustainable design choices.

Desiree Plata, the John J. Lee Assistant Professor of Chemical and Environmental Engineering and co-senior author, said they want to give engineers the means to avoid unintended consequences when creating materials.

"I think engineers of all categories are hungry for this type of information," she said. "They want to build materials that solve major crises of our time, like access to food and water and sustainable energy. The problem is they have no way to assess that sustainability in a quick and easy fashion. The article published today seeks to overcome that challenge and pave the way for sustainable nanotechnologies."

More information: Mark M. Falinski et al. A framework for sustainable nanomaterial selection and design based on performance, hazard, and economic considerations, *Nature Nanotechnology* (2018). DOI: 10.1038/s41565-018-0120-4

Provided by Yale University