Turning agents of disease into tools for health and better living

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Viruses that attack plants, insects, mammals and bacteria are proving effective platforms for delivering medicines and imaging chemicals to specific cells in the body, as building blocks for tiny battery electrodes and computer data storage devices, and other nanotechnologies.

The burst of research over the last two decades, with explanations aimed at undergraduate and graduate college students and scientists within and outside the field, is described in a new book written by Nicole Steinmetz, an assistant professor of biomedical engineering at Case Western Reserve University, and Marianne Manchester, a professor of pharmacy and pharmaceutical sciences at the University of California at San Diego.

The textbook, Viral Nanoparticles: Tools for Materials Science and Biomedicine, summarizes the work done by engineers, chemists, physicists, materials scientists, medical researchers and others; the viruses used and the applications. The book is available now.

"The field is rapidly expanding, with people from more and more backgrounds coming into it," said Steinmetz, who has been manipulating viruses since she was an undergraduate researcher. Earlier in her career she created multilayered thin film arrays made of multiple 3-dimensional viral nanoparticles for use in sensors or nanoelectronics, but is now focusing on the application of plant viruses for medical use, such as cancer detection and imaging and targeted drug delivery.

Manchester has long specialized in the interface between viral nanoparticles and physiologic systems, defining the ways that viruses interact with cell surfaces and organs within the body. "The field is now poised to move forward toward commercial and clinical applications," she said. "The book provides an overview of these challenges and opportunities".

Viruses are finding a wide range of uses in nanoscience and nanotechnology, because of a host of practical traits, she explains. Viruses are already nano-sized – 100,000s of times smaller than the width of a human hair. Their structures have been optimized by nature, physically and chemically each unit of the same strain of virus is identical, they're cheap and easy to produce and they easily self-assemble into two-and three-dimensional structures.

The infectious agents are also stable, hardy and biocompatible.

The book details how researchers have mineralized viruses to produce nanowires used in nanoelectronics, and build thin-film micro-arrays. The authors explain how scientists have rendered the infectious agents benign, as well as genetically or chemically altered versions for specific uses.

They tell how they and others have modified the surfaces of viral nanoparticles to link up with targets, such as tumor cells, and modified their interiors to carry medicines, fluorescent chemicals used in imaging applications, or other cargo.

More information: Viral Nanoparticles is published by Pan Stanford Publishing, Pte., Ltd., of Singapore. The book is available through Pan Stanford and on Amazon.com.

Provided by Case Western Reserve University