

NANOENGINEERING GONE VIRAL: PLANT VIRUS-BASED THERAPEUTICS TARGETING HUMAN, VETERINARY AND PLANT HEALTH

Nicole F. Steinmetz, Ph.D.



Abstract: Nanoscale engineering is revolutionizing the way we detect, prevent and treat diseases. Viruses are playing a special role in these developments because they can function as prefabricated nanoparticles. We utilize and build-upon the high-precision assemblies of the viral capsids and utilize them as platform technologies, engineered and repurposed for a desired function. More specifically, we turned toward plant viruses as a platform nanotechnology. We have developed a library of plant virus-based nanoparticles and through structure-function studies we are beginning to understand how to tailor these materials appropriately for applications targeting human, veterinary and plant health. Through chemical biology, we have developed virus-based delivery systems carrying active ingredients for therapy and prevention of disease. A particular exciting avenue is the development of plant virus-like particle platforms for cancer immunotherapy. The idea pursued is an 'in situ vaccination' to stimulate local and systemic anti-tumor immune responses to treat established disease, and most importantly to induce immune memory to protect patients from outgrowth of metastasis and recurrence of the disease. Another avenue is the repurposing of plant viruses to enable plant health; we employ principles of nanomedicine to target pesticides residing deep in the soil therefore challenging to reach using contemporary pesticides. I will highlight engineering design principles employed to synthesize the next-generation nanotherapeutics using plant virus-based platform technologies, and I will discuss the evaluation of such in preclinical mouse models and canine patients as well as in the agricultural arena.

Bio: Dr. Steinmetz is a Professor of NanoEngineering at the University of California, San Diego (07/2018-present). She is the founding Director of the Center for Nano-ImmunoEngineering (nanoIE) and serves on the Leadership Team for a UC San Diego Materials Research Science and Engineering Center (MRSEC). Dr. Steinmetz trained at The Scripps Research Institute, La Jolla, CA where she was a NIH K99/R00 awardee and AHA post-doctoral fellow (2007-2010); she obtained her PhD in Bionanotechnology from the University of East Anglia where she prepared her dissertation as a Marie Curie Early Stage Training Fellow at the John Innes Centre, Norwich, UK (2004-2007). Her early training was at the RWTH-Aachen University in Germany. Dr. Steinmetz's research program focuses on the engineering of plant virus-based nanomaterials targeting human and plant health applications, such as therapeutic delivery, molecular imaging, and next-generation vaccines and immunotherapies. Dr. Steinmetz has authored more than 200 journal articles (H index 56). Dr. Steinmetz is a Fellow of the Royal Society of Chemistry, a Fellow the American Institute of Medical and Biological Engineering; she has won many awards, including an American Cancer Society

(ACS) Research Scholar Award (2016), and a Young Innovator of Cellular and Molecular Bioengineering Award from the Biomedical Engineering Society (2015). Dr. Steinmetz's research program is supported through grants from NIH, NSF, NIFA, CDMRP as well as ACS, Susan G. Komen, AHA, amongst other agencies. Over the past 10 years, Dr. Steinmetz has been awarded grants as PI and Co-PI totaling \$41+ million in total costs.