High Throughput Nanocomposite Manufacturing Using Spray Technologies

Nanomaterials have tremendous commercial potential to enhance strength, enable emergent properties, and advance applications in computing, optoelectronics, and medicine. However, a critical roadblock, identified by the National Science Foundation’s “Sustainable Nanomanufacturing - Creating the Industries of the Future” report is the inability to make nanosized products at commercial scale. Many bench scale processes are focused on small, batch processes that cannot be easily scaled because of required energy inputs. Our research is focused on one crucial step for creating large-scale nanocomposites of polymers and inorganic nanoparticles, a common approach to yield water-soluble nanomaterials. We are investigating three approaches to scalable nanomanufacturing, based on electrospray, flash nanoprecipitation, and sonication methods. For each method, we evaluate the influence of process conditions on throughput, particle size, and emergent properties. In addition, we consider environmental, health, and safety implications of each approach. Finally, we discuss potential applications of these materials in medicine.

Jessica O. Winter, Ph.D.

Jessica Winter is a Professor in the William G. Lowrie Department of Chemical and Biomolecular Engineering and the Department of Biomedical Engineering, Associate Director of the MRSEC Center for Emergent Materials at the Ohio State University, and Chair of the Nanoscale Science and Engineering Forum of the American Institute of Chemical Engineers. She received her PhD in Chemical Engineering from the University of Texas at Austin in 2004, and completed a postdoctoral fellowship at the Center for Innovative Visual Rehabilitation at the Boston VA Hospital in 2006. Her research interests include nanoparticle development for cancer imaging and drug delivery and development of materials to study brain tumor microenvironment. She is a co-founder and Chief Scientific Officer of Core Quantum Technologies, a company commercializing nanoparticle reagents for cancer
diagnostics. She was named 2012 TechColumbus Innovator of the Year, Columbus Business First 40 under 40, and Columbus Business First 20 People to Know in Technology. In addition, she has received the American Chemical Society Rising Star Award and the Golden Mouse Trap Engineering Rising Star Award; she was named to Top 25 STEM professors in Ohio; and is a fellow of the AAAS, AIMBE, and senior member of the IEEE and AIChE.