Auto-electrokinetic flows from colloidal motors and pumps
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ABSTRACT:
Colloidal motors are micron-sized particles, often consisting of metals such as platinum, gold, or silver. They can also be made of various minerals, such as calcium carbonate. The motors have the ability to consume chemical energy and cause auto-electrokinetic flows. Electrokinetic flows follow the Stokes equations of hydrodynamics, and include a term due to electric body forces within the fluid. The motors thus move autonomously, often at >10 micrometers/sec. Not only can the motors self-move individually, but collections of the motors often give an emergent directed motion, much like bacterial populations that engage in chemotaxis or phototaxis movement. In this talk I will describe simple techniques for fabricating the motors or using existing minerals, examine the auto-electrokinetic flow mechanisms by which the motors move individually, and analyze how the motors communicate with each other and the system to achieve collective movement. Then we will explore several key challenges and opportunities with catalytic motors.

BIO:
Darrell Velegol attended West Virginia University for his BS in Chemical Engineering, and he earned his PhD in Chemical Engineering at Carnegie Mellon University in 1997 working with Professors John L. Anderson and Stephen Garoff. In 1998 Velegol won the Victor K. LaMer Award of the American Chemical Society for the best PhD in the field of Colloid & Surface Science. He continued with a post-doc in the Center for Light Microscope Imaging and Biotechnology at Carnegie Mellon, working under Professor Fred Lanni of the Biology Department. In June 1999 Velegol joined the Department of Chemical Engineering at Penn State, where he was promoted to Associate Professor in 2005. Velegol won an NSF CAREER Award in 2000, and has continued to be funded by NSF, DOE, EPA, PRF, the Air Force, and other agencies for his work with colloidal forces and colloidal assembly. His research investigates the fabrication of colloidal assemblies and devices, with a specialty in understanding the interparticle forces and sorting processes. His research group uses a wide range of experimental and modeling approaches. Velegol is a member of ACS, AIChE, AAAS, and ASEE. More recently, he has engaged in studying the "physics of community", pursuing questions in learning, creativity, motivation, trust and deceit, courage, and other social science ideas using results from physics, chemistry, biology, and chemical engineering. He is applying this research to "Wild Scholars", which aims to have an impact on grades 7-12 education throughout Pennsylvania and beyond. In 2009 Velegol was promoted to Full Professor at Penn State.