

## CAREER: The Integration of Biomolecular Motors for Bacterial Actuation, Sensing, and Transport (BAST) at Micro/Nanoscale

The research objective of this Early Faculty CAREER award is to develop the fundamental foundations for the use of flagellated bacteria as controllable, reconfigurable elements in a network of micro-engineered systems, and to adapt polymeric protein nanostructures for use in nanoscale devices. The intellectual merit of this project will be established through both innovative experiments and computational modeling of nanostructures and nanodevices that are of importance to diverse areas such as medicine, electronics, and energy disciplines. The focus will be on the use of the polymorphic transformation of bacterial flagella in a variety of applications including: direct actuation of nanoscale structural machines; fluid actuation through pumping and mixing; mechanical actuation including autonomous transportation systems; and electrical/electronic actuation through inorganic-organic nanotubes. The goal of the education plan is to bring relevant nano/microscale engineering physics of biological and fluid systems into the educational experience of undergraduate and graduate engineering students. Toward this goal, a course will be offered on the emerging technologies of nanoscale manufacturing and metrology for engineering and technology therefore creating enormous potential for an increased student learning experience.

If successful, the results of this research will lead to improved understanding of how the bacterial flagellar polymorphism might be designed to fabricate an entirely new class of nanoscale actuator and sensor systems. Experimental techniques developed in this program will have widespread application to other nanoscale systems in which fluids interact with nanoscale structures. The integrated education activities will contribute to bionanotechnology workforce training that is critical to the nation's manufacturing competitiveness. Outreach components will incorporate laboratory based experiential learning modules in nanotechnology for teachers and students of K-12 institutions in the Philadelphia region. These activities will instill greater appreciation for the importance of STEM education to groups that are traditionally under-represented in higher education.