ICTAS NEW HORIZONS SEMINAR SERIES

How Do You Make a Micro-Robot?

Engines and motors are everywhere in the modern world, but it is a challenge to make them work if they are very small. On the micron length scale, inertial forces are weak and conventional motor designs involving, e.g., pistons or flywheels cease to function. Biological motors work by a different principle and use catalysis to convert chemical to mechanical energy on the nanometer length scale. Together with Ayusman Sen and other colleagues at Penn State we have explored the concept of using catalysis to power synthetic nano- and micromotors. Bi- and trimetallic microwires are catalytically self-propelled in fuel-containing solutions at speeds that are comparable to those of flagellar bacteria. Despite the difference in propulsion mechanisms, catalytic motors are subject to the same external forces as natural micromotors such as bacteria. Therefore they follow the same scaling laws and exhibit similar emergent behavior (e.g., magnetotaxis, chemotaxis, schooling, and predator-prey behavior). Recently we have found that asymmetric nanowires also undergo autonomous motion and a range of collective behavior in fluids when excited by low power ultrasound. The acoustic propulsion mechanism may be particularly useful for diagnostic and biomedical applications because it is salt-tolerant and does not involve toxic chemical fuels.

ABOUT THE SPEAKER

Thomas E. Mallouk
Pennsylvania State University

Thomas E. Mallouk is the Evan Pugh Professor of Chemistry, Biochemistry and Molecular Biology, and Physics at the Pennnsylvania State University. His research focuses on the synthesis of inorganic materials and their application to solar energy conversion, catalysis and electrocatalysis, nano- and microscale motors, low dimensional physical phenomena, and environmental remediation. He is the author of approximately 400 publications, including a few good ones. He is an Associate Editor of the Journal of the American Chemical Society and Associate Director of the Penn State MRSEC, the Center for Nanoscale Science.

Tuesday, February 23, 2016
2-3:30 pm, 310 Kelly Hall

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