New Approaches to Energy Harvesting and Storage

T. Goodson III, The Richard Bernstein Collegiate Professor of Chemistry

Department of Chemistry, Applied Physics Program, and Macromolecular Engineering

As the need for enhanced energy harvesting and storage capabilities increases, the design and fabrication of real and new approaches to the energy storage market remains a major focus of developing technologies. The requirements for high density energy storage and fast energy release are critical now for a variety of important applications. High performance capacitors with low dielectric loss at high operational frequencies would enable greater acceleration in hybrid and electric cars (on highways for example); quicker switching response in electronic devices such as printed circuit boards, smaller size in portable devices such as laptops and defibrillators. With further advancements in materials, it has been shown that novel organic macromolecules are very promising for a broad variety of optical and electronic applications. A big advantage of organic high dielectric (capacitor) macromolecular materials investigated in the Goodson group at the University of Michigan is that they are cheap, easily processed and flexible with superior properties. Organic macromolecules have also shown properties of strong intra-molecular interactions which have been utilized in light harvesting processes and photovoltaic (solar) devices as well. The excitation mechanism in these systems depends on the nature of the geometrical orientation of covalently attached chromophores (pigments) and the extent of delocalization. In this presentation, new trends in the use of organic materials for energy harvesting and storage will be described.

Professor Theodore Goodson's Bio

Theodore Goodson III received his B. A. in 1991 from Wabash College and earned his Ph.D. in Chemistry at the University of Nebraska-Lincoln in 1996. After postdoctoral positions at the University of Chicago and at the University of Oxford, he accepted a position as Assistant Professor of Chemistry at Wayne State University in 1998. In 2004 he moved to the University of Michigan as Professor of Chemistry. In 2008 he was appointed as the Richard Barry Bernstein Professor of Chemistry at the University of Michigan. Dr. Goodson's research centers on the investigation of nonlinear optical and energy transfer in organic multi-chromophore systems for particular optical and electronic applications. His research has been translated in to technology in the areas of two-photon organic materials for eye and sensor protection, large dielectric and energy storage effects in organic macromolecular materials, and the detection of energetic (explosive) devices by nonlinear optical methods. He has investigated new quantum optical effects in organic systems which have applications in discrete communication systems and sensing. Goodson's lab was also the first to investigate the fundamental excitations in small metal topologies which are now candidates for tissue and other biological imaging. In 2009 he founded Wolverine Energy Solutions and Technologies Inc. a start-up company with contracts to produce high energy density capacitors for military, automotive, and medical devices. The company also developed a new system for the detection of IED's remotely with one of the patents award Goodson at the U of Michigan.

Dr. Goodson's awards include the Percy Julian Award, University of Michigan Distinguished Faculty Achievement Award, Lloyd Ferguson Lectureship, National Science Foundation American Innovation Fellowship, Sigma Xi Lectureship, Research Young Investigator Award, National Science Foundation CAREER Award, Alfred P. Sloan Research Fellowship, Camille Dreyfus Teacher-Scholar Award, Lloyd Ferguson Young Scientist Award, Burroughs Welcome Fund Award, American Chemical Society Minority Mentorship Award, University Faculty Recognition Award, College of Science Teaching Award, and a National Academy of Sciences Ford Postdoctoral Fellowship. Dr. Goodson has been a Senior Editor for The Journal of Physical Chemistry since 2007. Professor Goodson has been an active member of both the undergraduate admissions committee and recruiting committees for the University of Michigan and also serves with the college to enhance efforts of mentoring through-out the university in particular for mentoring students of diverse backgrounds. He has served on the Committee of Institutional Cooperation and the Editorial Advisory Board of the Journal of the American Chemical Society. Dr. Goodson has published over 110 scientific publications and more than 140 invited talks.