“Molecules and Materials by Design” Symposium

Supported by:
NASA Connecticut Space Grant Consortium
University of New Haven

Date: February 22, 2019
Location: Buckman Hall 120

9:25-9:55 am Prof. Ravi Gorthala, University of New Haven
A Novel Multi-Die, Multi-Stage (MDMS) Pultrusion Process for Manufacturing Hybrid Composites

10:00-11:00 am, Prof. Paul T. Anastas (Keynote Speaker), Yale University
Green Chemistry: The Path Forward

11:00-11:30 am, Prof. Shue Wang, University of New Haven
A novel synthetic toehold switch sensor for miRNA detection in mammalian cells

11:30-12:00pm, Prof. Pier Cirillo, University of New Haven
Design of new antibiotics based on marine natural products

Keynote Speaker

Paul T. Anastas, PhD
Yale University

Professor Paul T. Anastas is on the faculty of Yale University with appointments in the Department of Chemistry, the School of Engineering and Applied Sciences, The School of Forestry and Environmental Studies, School of Medicine and the School of Management. He is widely known for his work in pioneering the field of Green Chemistry and has published 13 books on sustainable technology. He has experience in business (co-founded three companies), the NGO world (co-founded the Green Chemistry Institute), and government having served in the Administrations of the past three U.S. Presidents including serving in the White House Office of Science and Technology Policy in the Clinton and Bush Administrations and as Assistant Administrator and Chief Scientist at the U.S. Environmental Protection Agency in the Obama Administration. Selected awards include: Heinz Award, Rachel Carson Prize, E. O. Wilson Prize, Emanuel Merck Medal.

Keynote Seminar &
Alvine Lecture at the Tegaliatella College of Engineering

Green Chemistry: The Path Forward

Paul T. Anastas, PhD
Yale University

The history of the field of green chemistry is being written every day in the lab notebooks and the scientific journals. But the impact of the basic science goes far beyond the basic research to impact the lives and well-being of the living things of the planet. The work of green chemistry will be a significant factor in whether or not we stay on the unsustainable trajectory that we are on as a civilization. With that in mind, what becomes the essential elements for the work of green chemistry. Is it simply to make existing products and processes more efficient and less wasteful? If it's something more than that, then how do identify the "True North" and what is the path forward?

A Novel Multi-Die, Multi-Stage (MDMS) Pultrusion Process for Manufacturing Hybrid Composites

Ravi Gorthala, Ph.D.
University of New Haven

Can we imagine plastics dominating the world of conventional structural materials -- steel, aluminum, concrete, wood, etc.? The word "*plastics*" may indicate a "No" to this question. But, if one says *advanced polymer composites or fiber reinforced plastics (FRP) or structural plastics*, the answer may be different since advanced polymer composites have been rivaling their metal counterparts for the past two decades. Whether composites will take the lead over conventional materials or not, their presence is being seen in every structural application. The aerospace industry was one of the first to adopt composites, but they are now penetrating civil infrastructure, the automotive industry, chemical and process industries, consumer industries, energy sectors and building construction.

Polymer composites are fabricated by a variety of processing techniques, including pultrusion, pressure molding (both compression molding and autoclave processing), hand lay-up, resin transfer molding (RTM), filament winding, and thermoforming. As outlined below, pultrusion is, and will continue to be, the best method for fabricating constant cross-section structural members:

- *Pultrusion is the most cost-effective process for making polymer-matrix composite materials*. This initial substantial cost advantage over other fabrication techniques is a highly attractive feature when one is attacking the high-cost barrier to acceptance and use of composites.

- *Pultrusion is a continuous process and can produce any transportable length product.* For instance, a small-diameter fiber optic cable core that is 1.4 mile long can be pultruded, and then wound on a spool. No other composite fabrication process features this advantage.

Hybrid pultrusion process takes the composites manufacturing to the next level.. This presentation will outline the process and highlight the potential for tailoring polymer composite materials even further.

A novel synthetic toehold switch sensor for miRNA detection in mammalian cells

Shue Wang, Ph.D.
University of New Haven

MicroRNAs (miRNA or miR) are short noncoding RNA of about 21-23 nucleotides that have been demonstrated to play critical roles in multiple aspects of biological processes by mediating translational repression through targeting messenger RNA (mRNA). Conventional methods for miRNA detection, including RT-PCR and Northern blot, are limited due to the requirement of cell disruption. In this talk, I will talk about an engineered synthetic miRNA toehold switch for detection of miR-155 in different types of mammalian cells. Also, I will talk about a locked nucleic acid (LNA) sensor for real-time monitoring of transcription and translation dynamics in a HeLa-based cell-free expression (CFE) in bulk and in cell-sized single emulsion droplets.

Design of New Antibiotics Based on Marine Natural Products

Pier F. Cirillo, Ph.D.
University of New Haven

Resistance of pathogenic bacteria towards our present arsenal of antibiotics is on the rise. Hence, there is an urgent need to discover new classes of chemotheapeutic agents, with either new chemical structures that bind to the established targets, or new modes of action. The "Golden Age" of antibiotic discovery (1940-1962), marked mostly by empirical screening of microbial fermentation broths, has been followed by decades of an innovation void. A promising avenue to fill this void may be the mining of marine organisms for selectively toxic metabolites. Novel, highly halogenated compounds have been identified and been shown to possess potent activity against Gram-positive bacteria such as Methicillin-resistant *Staphylococcus aureaus* (MRSA). Cadiolides, isolated from ascidians and tunicates, are one example of such compounds. In this talk, I will present our efforts towards the total laboratory synthesis of such compounds and their analogs, as well as the rationale for some of the designed analogs.