UNIVERSITY OF RHODE ISLAND
Department of Chemistry
Ph.D. Seminar

Room 105 Beaupre
3:00 P.M., Monday, March 28, 2022

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"Leveraging organic chemistry for the development of green technologies"

HOST

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Leveraging organic chemistry for the development of green technologies

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A fundamental goal of organic chemists is to develop reactions and technologies that limit the environmental impact of scientific research. This work will focus on two ideas: the improvement of storage methods for hydrogen gas and the development of an organic catalyst for the synthesis of various bioactive small molecules.

Hydrogen gas as a fuel is a promising emerging technology as it is a carbon-free fuel with a high energy density by mass. However, as a gas or liquid, it has a low energy density by volume, underperforming most carbon-based fuels. In addition, hydrogen brings difficulties in storage and transport due to its flammability hazards. In this work, we have developed a process that allows for an on-demand photoinitiated release of hydrogen from a petroleum-based organic dye. 9-anthracenemethanol covalently stores one equivalent of hydrogen gas that can be released with blue light. Furthermore, its oxidized form, 9-anthraldehyde, can be catalytically hydrogenated back to the alcohol. This process opens new options for solid-state hydrogen transport and storage with facile, hazardless on-demand release using solar energy.

In our second field of work, a phase transfer organic macrocyclic catalyst was developed. The noria and R3 macrocycle isomers have been studied due to their unique multi-binding capabilities. Our work has used these to act as a method for enhancing the synthesis of small molecules by functionalizing the outer binding pockets with sulfonic acid groups. Due to their unique structure, these macrocycle catalysts have shown good yields in the Pechmann and Biginelli syntheses at catalyst loadings as low as 0.25 mol%. This catalyst showed good yields over substrate scopes of two separate reactions, while maintaining a high recyclability, losing 7% yield over five reaction cycles. Our work has shown the potential for organic macrocyclic catalysts in improving yields in neat or aqueous environments at lower loading than other predecessors.