

CHEMISTRY SEMINAR

Toward the synthesis of a library of triazine-based, biodegradable, ionizable lipids

By Emily Howe '23 BMB

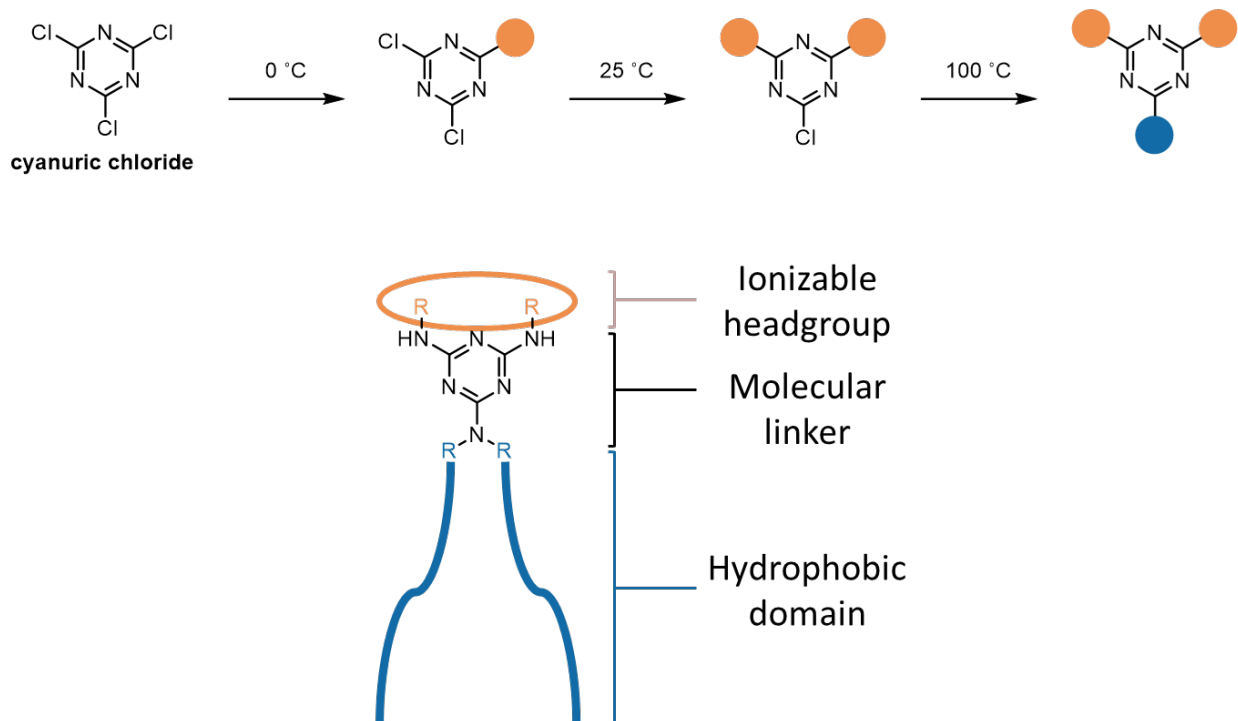
11:30 a.m.

April 13, 2023

Darrah Auditorium
McCreary Hall Room 101

Abstract:

Lipid nanocarriers (LNCs) are the leading non-viral delivery systems for genetic drugs. A variety of molecular cargo, including nucleic acids and small molecules, can be encapsulated by LNCs and targeted for delivery to a specific tissue. Ionizable lipids are of particular interest, as the pH of specific cellular compartments may alter the charge of the lipids and ultimately the structure of the LNC, allowing for targeted release of the molecular cargo. The physiochemical and biological properties of liposomes can be modulated by altering those of the lipids which make up the nanocarriers. The need for uniquely designed liposomes for varied cargos and target effects necessitates the synthesis of a library of lipid-like molecules with diverse hydrophilic headgroups and hydrophobic tails for a variety of LNC formulations. The present work describes the synthesis and characterization of several species of lipid-like molecules based around cyanuric chloride, a triazine with three available sites for temperature-controlled nucleophilic aromatic substitution. A small number of studies have shown that triazine-based lipids can form LNCs and transfect cells, but no studies to date examine triazine-based lipids containing ester groups in the hydrophobic tails, a common moiety used to introduce biodegradability and reduce cytotoxicity of synthetic lipids. This research integrates the use of cyanuric chloride as a linker molecule between hydrophilic headgroups and ester-containing, hydrolyzable hydrophobic tails, detailing the synthetic steps to create a library of lipids with a variety of fatty acid tails. Additionally described here are lipid-like molecules with headgroups which vary in the length of the saturated hydrocarbon chain connecting the triazine ring to the ionizable primary amine group, allowing any functional effects of this linker length to be probed.



CHEMISTRY SEMINAR

Synthesis and characterization of new cobaloxime-acetylide derivatives

By Erin McGrath, Chemistry '23

11:30 a.m.

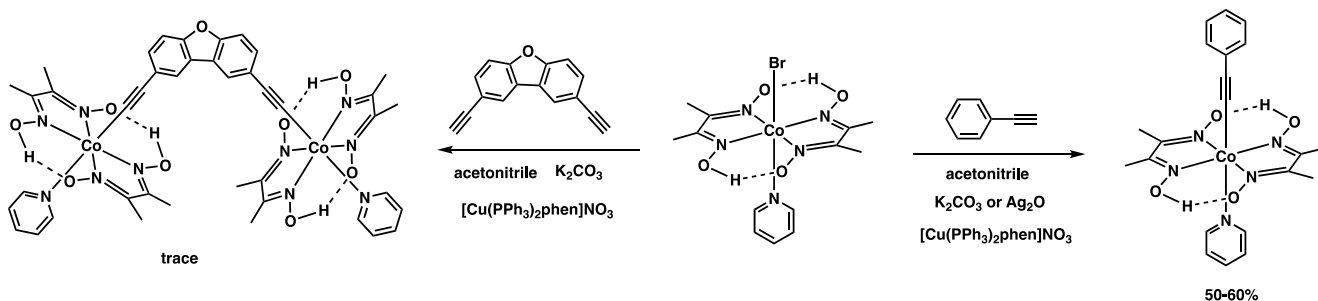
April 13, 2023

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Abstract:

Cobaloximes are octahedral cobalt complexes which are good model complexes for the co-enzyme vitamin B₁₂, which possesses a unique Co-C bond. Cobaloximes displaying Co-C bonds have been extensively studied over the last fifty years with the notable exception of Co-C(sp) species. Interest in cobaloximes has recently been renewed by examples of their use as components in both solar hydrogen production catalysts and photochemical C-C bond-forming catalysts. The existence of stable acetylides of many transition metals and reports of several stable Co(III)-acetylides that exist in other ligand contexts encouraged us to attempt to fill this gap among organometallic cobaloximes.

Over the course of over a year, dozens (and dozens) of variations in conditions (cobaloxime derivative, solvents, bases, catalysts, acetylide source) were attempted in vain. Finally, acetonitrile solvent and a moderately strong, insoluble base, along with Cu(I) catalysis, finally resulted in modest, but reproducible yields of cobaloxime acetylides. With the successful synthesis of a “simple” cobaloxime acetylide, we attempted the preparation of a binuclear cobaloxime bridged by a dialkyne. NMR of the diamagnetic Co(III) complexes was used to confirm their structure.



CHEMISTRY SEMINAR

Smart-Solvent Covalent Organic Frameworks and Impact on Wastewater Treatment

By Julia Wert, Chemistry'23

11:30 a.m.

April 13, 2023

Darrah Auditorium
McCreary Hall Room 101

Abstract:

With the advancement in modern industrializations, a serious threat arises to the environment with the discharge of a large number of toxic pollutants, including organic dyes and pesticides, in bodies of water. Traditional methods using adsorbents to remove such toxins have the disadvantages of high energy consumption, low efficiency, and complex operations which impede their developments. Therefore, there has been an increase interest in developing alternative separation techniques, including membrane-based separations with easy operation, low energy consumption, and environmental friendliness. The main factors dictating the success of membrane performance are permeability and selectivity, however the trade-off between these two factors have made it difficult to achieve both high permeability and high selectivity.

In recent research, smart-gating covalent organic frameworks have been fabricated in order to respond to external stimuli (such as pH, temperature, light, etc.) and regulate their pore sizes under various conditions. Covalent organic frameworks (COFs) are an emerging class of crystalline porous materials with a large surface area, tunable pore size and structure, and exceptional stability. The introduction of special functional groups or monomers allows these COFs to respond to a variety of stimuli and conditions. These COF membranes showed higher dye rejection performance in water than acetone and demonstrated pore size regulation in different solvents. This research not only provides the groundwork for smart COF membranes, but also broadens the potential applications of COF materials.

