Organic Chemistry Seminar

Tuesday, October 31, 2023
4:30 p.m. ~ WTHR 104

"Synthesis of Sequence Defined Nanostructures for Selective Molecular Recognition"

Olav Vestrheim

Graduate Student, Purdue University

Bio-sketch:
Olav started his academic career at Bergen University college in Norway where he got this bachelor's degree in chemical engineering, he then moved to the University of Copenhagen in Denmark for this master's degree in chemistry, followed by a move to the University of Vermont where he spent three years working on his PhD. He now finds himself at Purdue University to finish his PhD.

Abstract:

Both natural and synthetic macromolecules have gained significant attention over the last two decades as more and more applications have been developed for these types of compounds. In particular, drug delivery and sensing have seen great improvements with the use of biomimetic- and biomacromolecules. A key function for these macromolecules is selective recognition, which has evolved in nature over millions of years, but is difficult to replicate in the laboratory. An essential component of selective recognition is sequence definition of the host, which is a key characteristic found in biomolecules and is essential for the function of proteins and nucleic acids. In this work, I present new methods for creating biomimetic sequence-defined macromolecules through the synthesis of a new sequence-definable macrocycle, an amino acid-functionalized Fréchet-type sequence-defined dendrimer, and a range of new molecular cages. The molecular cages I present in this work are of varying sizes and with different endo- and exohedral functionalities intended for future use as selective recognizers. The macrocycle presented in this work is the largest sequence-definable macrocycle reported to date with 20 functionalizable positions, synthesized via iterative exponential growth using a series of copper-catalyzed azide-alkyne cycloadditions (CuAACs). Synthesis of an amino acid functionalized fully sequence-defined Fréchet-type dendrimer was also attempted through a convergent synthesis via a series of CuAACs. However, in this project, I could only reach a second-generation dendron due to solubility issues. This issue should be resolvable in the future by adding solubilizing chains to the dendrons. Finally, a series of new large molecular tetrahedrons were synthesized, enabled by the development of a more facile synthesis of a previously developed vertex. This new methodology made it possible to quickly access large quantities of this key tetrahedron vertex. With the vertex, I was able to synthesize nine new molecular tetrahedrons of various sizes with pore openings of up to 33 Å and with volumes up to 17 nm3.

PURDUE UNIVERSITY | Department of Chemistry