Rice University
Molecular and Nanotechnology
Seminar Series

Presents

Dr. Carson Bruns

Miller Research Fellow
College of Chemistry
University of California, Berkeley

Thursday, January 19, 2017 - 2:30 PM
Herzstein Hall 210

The Molecular Ring-and-String Materials

Threading a string through the eye of a ring is not a trivial task if the ring and string are both molecules. Since we lack the dexterity on the nanoscale to guide a molecular string through the eye of a ring mechanically (as we do on the macroscale), we must instead rely on chemical interactions and reactions that cause ring and string molecules to self-assemble into threaded structures, in spite of their random Brownian movements. If a ring becomes permanently trapped on a string, these two molecular component parts are said to share a mechanical bond. I am interested in uncovering ways in which this non-canonical bond can give rise to emergent types of chemical structures, dynamics, and functions. In this seminar I will describe how (i) the efficiency of molecular ring-threading events can be controlled by confinement within self-assembled molecular nanoflasks, and also how mechanically bonded ring-and-string molecules known as rotaxanes can be fashioned into (ii) “molecular muscles” that expand and contract in response to electrochemical and thermal stimuli, (iii) oligomers and polymers with well defined, folded superstructures akin to proteins, (iv) stimulus-activated probes for magnetic resonance detection technologies such as NMR and MRI, and (v) the first protein bioconjugates with mechanical bonds. This research suggests that, although it is not a chemical bond, the mechanical bond is equally capable of influencing the structures, dynamics, and functions of molecular materials.

About the Speaker

Carson J. Bruns, presently a Miller Research Fellow in the College of Chemistry at the University of California, Berkeley, was born and raised in Northern Colorado before attending Luther College in Decorah, Iowa (2004–2008), where he earned degrees in chemistry, religion, and mathematics. Under the joint supervision of J. Fraser Stoddart and Sam Stupp, he received a PhD in organic chemistry from Northwestern University in 2013, where he was awarded research fellowships from the National Science Foundation (NSF) Graduate Research Fellowship Program (GRFP) and East Asia and Pacific Summer Institutes (EAPSI), as well as the Japan Society for Promotion of Science (JSPS) Summer Program, the Global Center of Excellence at the University of Tokyo, and the World Class University Project at the Korean Advanced Institute of Science and Technology (KAIST). Carson’s research interests, which span organic, inorganic, polymer, and biochemistry have focused broadly on soft materials, especially those involving organic photovoltaics and artificial molecular machines based with mechanical bonds.

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