

The University of West Florida
Department of Chemistry



William D. Smart Seminar
Series in Chemistry

Speaker: Dr. Fraser Stoddart, Board of Trustees Professor
Northwestern University
Date: Thursday, October 23rd
Location: Institute for Human and Machine Cognition
40 South Alcaniz St, Pensacola, FL
Time: 5:30 PM - Reception
6:00 PM - Lecture

Seminar Title: Mingling Art with Science

Abstract

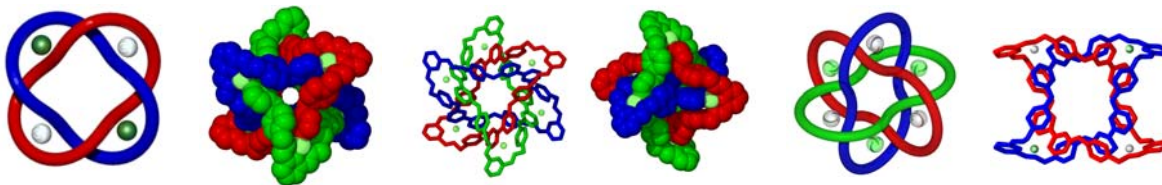


It was Marcellin Berthelot (1827-1907) who, in 1860, stated, “Chemistry creates its object.” He continued, “This creative capability, resembling that of art itself, distinguishes it essentially from the natural and historical sciences.” As one of Berthelot’s most fervent disciples these past 35 years, I have been a sculptor of matter at the ultimate of size levels that equates with being a chemist – namely, the molecular level. I have faced formidable challenges, yet derived no end of pleasure from designing and synthesizing molecular compounds of a somewhat bizarre kind. These exotic compounds contain, in addition to the classical chemical bonds, a mechanical bond. My presentation will draw attention to how art in its many different guises has fashioned my chemistry in its numerous diverse shapes and forms over the years.

An example is the realization of the Borromean Link in a wholly synthetic molecular form. The self-assembly of this link, which is topologically achiral, from 18 components by the template-directed formation of 12 imine and 30 dative bonds, associated with the coordination of three interlocked macrocycles, each tetranucleating and decadentate overall, to a total of six zinc(II) ions, is near quantitative. Three macrocycles present diagonally in pairs, six *exo*-bidentate bipyridyl and six *endo*-diiminopyridyl ligands to the six zinc(II) ions. The use, in concert, of coordination, supramolecular, and dynamic covalent chemistry leads to the highly efficient construction, by multiple cooperative self-assembly processes, of a nanoscale dodecacation with an approximate diameter of 2.5 nanometers and an inner chamber of volume 250 cubic Ångstroms, lined with 12 oxygen atoms. Taking advantage of the ability to preorganize six metal ions spatially and symmetrically, other metals with interesting redox properties were used to construct more so-called Borromeanes. Additionally, conditions were

used in which metals were mixed and led, quite unexpectedly, to the formation of another topological entity, known as King Solomon's Link.

Just as an interest in art history and topology took me into the molecular world of the Borromean Link so did the chance discovery of the molecular Solomon Link, amongst some Borromeanes, take me back into the arena of art history. And so the process goes on and on. One culture feeds off the other in a seamless manner.



- 'Molecular Borromean Rings', *Science* **2004**, *304*, 1308–1312.
- 'Nanoscale Borromean Rings', *Acc. Chem. Res.* **2005**, *38*, 1–9.
- 'Dynamic Nanoscale Borromean Links', *Chem. Commun.* **2005**, 3391–3393.
- 'Nanoscale Borromean Links for Real', *Chem. Commun.* **2005**, 3394–3396.
- 'Nanoscale Borromeanes', *J. Org. Chem.* **2005**, *70*, 7956–7962.
- 'Chiral Borromeanes', *Angew. Chem. Int. Ed.* **2006**, *45*, 4099–4104.
- 'A Molecular Solomon Link', *Angew. Chem. Int. Ed.* **2007**, *46*, 218–222.
- 'Making Molecular Borromean Rngs. A Gram-Scale Synthetic Procedure for the Undergraduate Organic Lab', *J. Chem. Ed.* **2007**, *84*, 855–859.