Coordination Self-Assembly: From Origins to the Latest Advances

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Molecular self-assembly based on coordination chemistry has made an explosive development in recent years. Over the last >30 years, we have been showing that the simple combination of transition-metal's geometry (typically, a 90 degree coordination angle of Pd(II) center) with organic bridging ligands gives rise to the quantitative self-assembly of nano-sized, discrete organic frameworks. Representative examples include square molecules (1990), linked-ring molecules (1994), cages (1995), capsules (1999), and tubes (2004) that are self-assembled from simple and small components. Originated from these earlier works, current interests in our group focus on i) molecular confinement effects in coordination cages, ii) solution chemistry in crystalline porous complexes (as applied to "crystalline sponge method"),[1] and iii) and giant self-assemblies[2], as disclosed in this lecture.

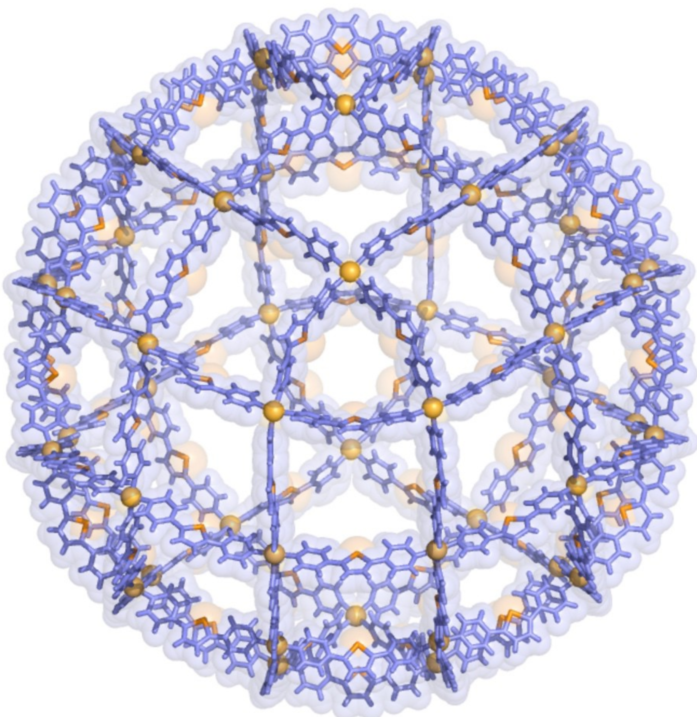

Figure 1. X-ray structure of $M_{48}L_{96}$ complex.

Reference

[1] Y. Inokuma, S. Yoshioka, J. Ariyoshi, T. Arai, Y. Hitora, K. Takada, S. Matsunaga, K. Rissanen, M. Fujita *Nature* **2013**, *495*, 461-466.

[2] D. Fujita, Y. Ueda, S. Sato, N. Mizuno, T. Kumasaka, M. Fujita, *Nature* **2016**, 540, 563.

Brief biography of Makoto Fujita

Makoto Fujita is a University Distinguished Professor at Tokyo College, The University of Tokyo, Japan. He earned his Ph.D. from the Tokyo Institute of Technology in 1987. After holding positions at Chiba University and the Institute for Molecular Science (IMS) in Okazaki, he became a full professor at Nagoya University in 1999. In 2002, he moved to The University of Tokyo, where he was appointed a full professor. He received his current title as a University Distinguished Professor in 2019.

His research interests include: (1) Coordination Self-Assembly: He focuses on constructing nanoscale, discrete frameworks, such as M_nL_{2n} Archimedean/non-Archimedean solids, through self-assembly induced by transition-metal ions. (2) Molecular Confinement Effects: His work involves developing and creating new properties and reactions by confining molecules within the cavities of self-assembled coordination cages. (3) Crystalline Sponge Method: This groundbreaking technique utilizes single-crystal-to-single-crystal guest exchange within the pores of self-assembled coordination networks. It's a new X-ray method that doesn't require the crystallization of target compounds.

Some of the important international awards and honors he has received include the 2004 Izatt-Christensen Award, 2013 ACS Arthur C. Cope Scholar Award, the 2018 Wolf Prize in Chemistry, the 2022 Grand Prix de la Fondation de la Maison de la Chimie, and the 2025 honorary foreign member of the American Academy of Arts and Sciences (AAAS).

He has maintained a close relationship with Strasbourg University. In 1996, he spent six months as a *Visiting Scholar* in the Sauvage laboratory, and subsequently returned for two short stays as a *Visiting Professor* in 1999 and 2002. He was invited by the University as the *John Osborn Lecturer* in 2015.