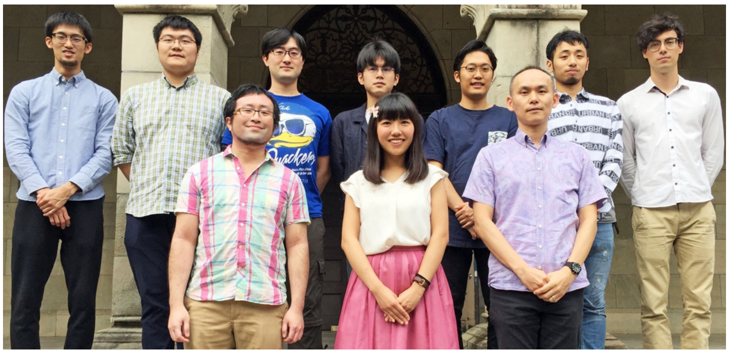
Quantitative Analysis of the Self-Assembly Process of Hexagonal Pt^{II} Macrocyclic Complexes: Effect of the Solvent and the Components



Front row from left to right Dr. Tatsuo Kojima, Ayako Baba, and Prof. Shuichi Hiraoka

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Invited for the cover of this issue is the group of Shuichi Hiraoka at the University of Tokyo. The image depicts a stylized view of a hexagonal platinum macrocyclic complex. Read the full text of the article at 10.1002/chem.201702955.

What prompted you to investigate this topic?

We see many self-assembled architectures in nature and know that self-assembly is one of important phenomena to organize life system. Inspired by biological self-assemblies, many chemists have created a number of artificial self-assembled structures for the past two decades. However, when we are asked a simple, fundamental question how the pieces of the assembly spontaneously come together to lead to such a well-ordered structure, we are all stuck for the answer. Considering that the development of chemistry is fueled by a natural desire to understand how it happens and what governs a phenomenon, in-depth understanding of self-assembly process should not only satisfy our intellectual curiosity but also unveil a mystery of living systems. In addition it may be possible to create novel assembled structures that have never been realized by understanding the mechanism. We started to touch this question four years ago, originally proposing a method for the investigation of the self-assembly process, which we call QASAP (quantitative analysis of the self-assembly process).

What is the most significant result of this study?

In the synthesis of macrocycles, undesired byproducts such as longer oligomers are often co-generated, so it is natural to expect that the self-assembly of coordination macrocycles should also take place, transiently producing longer oligomers. Contrary to our intuition, there are no longer oligomeric species formed than that found in the final macrocycles during the self-assembly.

What other topics are you working on at the moment?

We currently study a self-assembling system that utilizes hydrophobic effects and van der Waals (vdW) interaction in water. These molecular interactions are weaker than other molecular interactions and not directional, and thus considered to be improper for a discrete and stable self-assembly. However, we found that it is possible to construct a discrete and stable assembled structure only utilizing hydrophobic effects and vdW interactions if we appropriately design hydrophobic surfaces. The indented hydrophobic surface of the amphiphile meshes with each other, like Japanese "Hozo", and affords a discrete cubic hexamer, "nanocube", which is thermally very stable, even though very weak molecular interaction sticks the components together. We are now pursuing the chemistry of molecular Hozo.