Structural Control of [3]Catenanes Composed of Cyclic Porphyrin Dimers via Complexation with Amine Templates

([1]*Graduate School of Arts and Science, The University of Tokyo*) ○Yuki Oka[1], Hiroshi Masai[1], Jun Terao[1]

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Catenanes have the potential for applications such as molecular machines owing to the unique motility among mechanically interlocked cyclic components.[1] So far, most of catenanes functionalized by switching between the only two states of their supramolecular structures to change the motility of cyclic components. For further extension of higher-order functionalized catenanes, it is desired to develop methodologies for manipulating the more complicated motilities of cyclic components and to output the controlled motility as the functionality of catenanes. In this work, we achieved three-states switching of motility of cyclic components by synthesizing [3]catenane **1** composed of three cyclic porphyrin dimers (**Fig 1**). The [3]catenane **1** formed different supramolecular structures **2** and **3** utilizing coordination bonds between Ru or Zn porphyrins and multidentate amine ligands **L1** or **L2**. In case of **2**, all of three cyclic components were connected through Zn–N and Ru–N coordination bonding with **L1**. On the other hand, in **3**, only two cyclic components were connected via complexation with **L2**. Thus formed different supramolecular structures of [3]catenanes that had different motility of cyclic components depending on how cyclic components were connected through coordination bonds. Furthermore, fluorescence measurements revealed that the manipulation of cyclic component motilities leads to the regulation of communication among multiple cyclic components of [3]catenane.

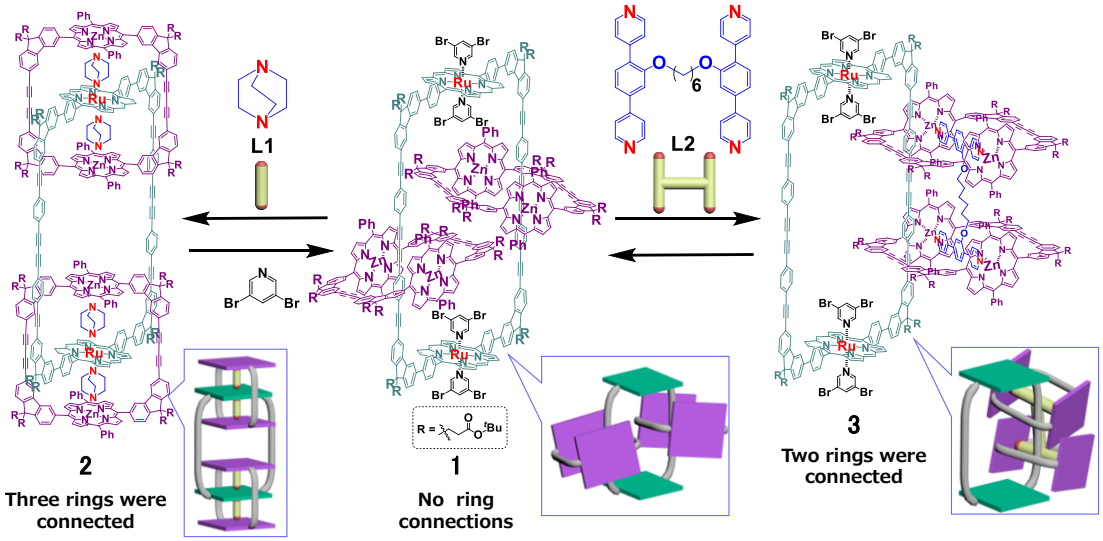

Figure 1. Structure of the [3]catenane **1** and switching of its supramolecular structures.

1) Gil-Ramírez, G.; Leigh, D.A.;Stephens, A. J. *Angew. Chem., Int. Ed.* **2015**, *54*, 6110.