

結晶中で動くロタキサン分子機械

Mechanical motions of rotaxane crystals

台湾清華大化工 ○堀江 正樹

Dept. of Chem. Eng., National Tsing Hua Univ., Taiwan

E-mail: mhorie@mx.nthu.edu.tw

Molecular machines have been intensively investigated. Recently this research has been extended to crystalline rotaxane materials.¹⁻⁵ In this presentation, we report the mechanical switching of rotaxane crystals induced by laser irradiation and temperature control (Fig. 1).²⁻⁵ The expansion/contraction of the crystals are induced by a 445-nm laser on/off. Single crystal X-ray crystallography provides the detailed structural changes of the rotaxane molecule. These changes correspond to a change in the size of the crystals with laser irradiation. A microswitch in an electric circuit is demonstrated using a rotaxane crystal (Fig. 1 middle).² The gold-coated rotaxane crystal was placed within a few micrometres of a Cu plate, and these terminals are connected to an electric circuit. The current can be changed by the laser switching on/off. This switching can be repeated more than 500 times without degradation within 60 s.²

The dynamic photoresponse of rotaxane crystals with azobenzene and ferrocenyl groups in the axle component is also investigated.⁴ Repeated alternating laser irradiation of the crystals at 360 and 445 nm produced bending in opposite directions. Under 445 nm irradiation, bending took place within 0.3 s. The rotaxane crystals have two chromophores, bent rapidly and reversibly on irradiation at rates depending on the molecular structure. Such photoinduced molecular switches have many potential applications in mechanical and optoelectric devices based on the simple integration of the interlocked molecules.

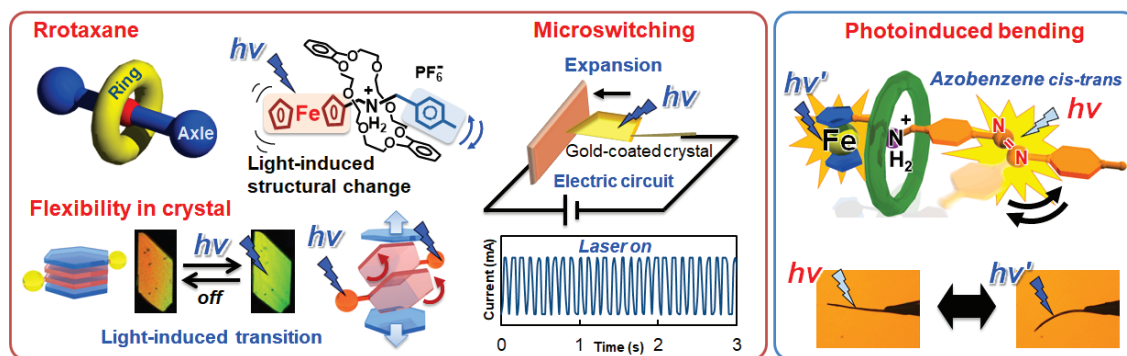


Fig. 1 Photoinduced switching of rotaxane crystals.

[参考文献]

1. M. Horie *et al.* *J. Am. Chem. Soc.* **2012**, *134*, 17932.
2. M. Horie *et al.* *Nat. Commun.* **2016**, *7*, 13321.
3. M. Horie *et al.* *Sci. Rep.* **2017**, *7*, 14195.
4. M. Horie *et al.* *J. Am. Chem. Soc.* **2018**, *140*, 90.
5. M. Horie *et al.* *Cryst. Growth Des.* **2019**, *19*, 17.