Phototunable Superhydrophobic Surface Mimicking the Lotus Leaf by Using Photochromic Diarylethene

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Previously, we reported reversible photoinduced crystal growth and melting of diarylethene derivative **1**. Then, we fabricated the surfaces showing lotus effect and rose petal effect by controlling the UV irradiation and heating procedures.[1] In nature, the lotus leaf is well-known as a typical example of superhydrophobic surface, whose wettability attributed to the micro-nano structures called “double roughness structure”. This time, we tried to regenerate the superhydrophobic surface as self-cleaning materials having double roughness structures, which showed superhydrophobicity just like that of the lotus leaf, by controlling the crystal growth of a diarylethene **1c**.

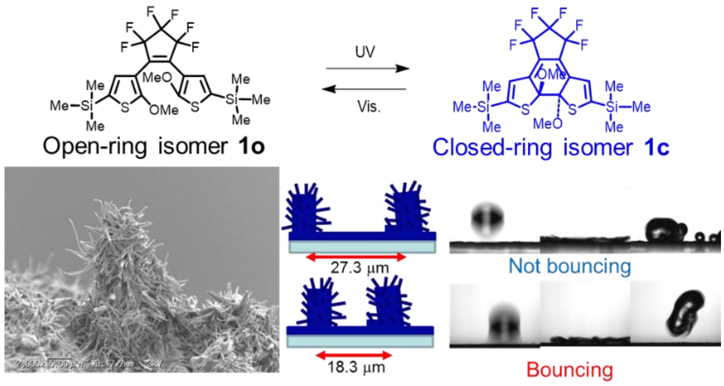

Figure 1. Molecular structure of **1**, and side view SEM image of diarylethene double roughness structure, and water drop bouncing phenomena on two different surfaces with different intervals between the larger size projections. Scale bar: 5 μm.

Upon irradiation with UV light to the microcrystalline surface of **1o** and followed by heating in the dark, the surface was covered with rod-shaped crystals of **1c**. Once again, upon irradiation with UV light to the surface and followed by heating in the dark, rod-shaped crystals became larger through the Ostwald ripening. The sizes of fattened crystals were 10 μm in diameter and 20 μm in height, whose sizes were same as those of large projections of the lotus leaf. Upon irradiation with visible light to that surface, cubic-shaped crystals of **1o** were generated on the rod-shaped crystals of **1c**. Finally, upon irradiation with UV light and followed by heating in the dark, double roughness structures were generated and the surface showed superhydrophobicity with contact angle (CA) of a water droplet was 161°.[2] Although no difference of CA was observed between the double roughness surface and the single roughness surface, bouncing phenomenon of a water droplet on each surface was different. On the lotus leaf and diarylethene double roughness surface, a water droplet was bounced, while, no bouncing phenomenon was observed on the single roughness surface. Consequently, we succeeded to regenerate the super water repellency of the lotus leaf by mimicking the surface structures of lotus leaf. Then, we released a water droplet from 15 cm high, no bouncing phenomenon was observed on the mimicked surface unlike the bouncing on the surface of lotus leaf. The reason of no bouncing was due to the low Laplace pressure attributed to the surface structures. In order to increase the Laplace pressure, we make the interval between the larger projection narrower. Consequently, we clarified that the relationship between the surface structure and superhydrophobicity which bounced off a water droplet by increasing the Laplace pressure by modifying the surface structures.

[1] K. Uchida *et al., Angew. Chem. Int. Ed.* **2010**, *49*, 5942 –5944.

[2] R. Nishimura *et al., J. Am. Chem. Soc.* **2016**, *138*, 10299−10303.