High-Speed Bending of Salicylideneaniline Crystals by Photothermal-Induced Natural Vibration

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Mechanically responsive organic materials have attracted much attention in both basic research and applications to smart actuators and soft robots.[1] We have developed many light-driven mechanical crystals over the past decade, mainly based on photoisomerization.[2,3] Recently, we reported 25 Hz fast bending of a molecular crystal by a photothermal effect, a phenomenon by which heat is generated by nonradiative deactivation of the photoexcited state during a photophysical process.[4] We then focused on a salicylideneaniline derivative with an *o*-amino substituent (enol-**1**, Figure 1a) and elucidated the bending mechanism that a nonsteady temperature gradient in the thickness direction triggers photothermally driven crystal actuation, ultimately achieving 500 Hz high-speed bending.[5]

Following this finding, we remeasured photothermally driven bending of another enol-**1** crystal (Figure 1b) using a higher performance high-speed camera. Upon ultraviolet (UV) light irradiation for 0.1 s, the crystal bent away from the light source to reach 1.4° after 0.1 s by the photothermal effect (Figure 1c). We analyzed the bending motion in detail and discovered that the crystal oscillated while bending (Figure 1c, inset); it was revealed that this oscillation (773 Hz) is derived from natural vibration of the crystal. The crystal was then exposed to a pulsed UV light of the same frequency as its natural frequency; the bend angle was amplified to 7.2° by resonance, achieving high-speed and large bending of 773 Hz (Figure 1d). It was revealed that fast and large bending can be generated by using photothermal-induced natural vibration.

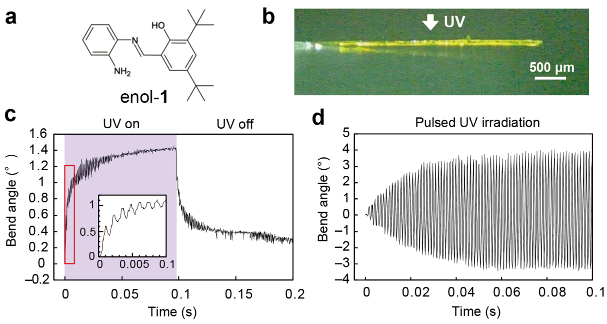

Figure 1. (a) Molecular structure of enol-**1**. (b) Photograph of an enol-**1** crystal viewed from the side face. (c) Photothermally driven bending upon UV irradiation for 0.1 s. (d) 773-Hz high-speed bending by photothermal-induced natural vibration upon pulsed UV irradiation (773 Hz).

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