Near-infrared Light Induced Mechanical Motions of Organic Crystals Coated with Photothermal Conversion Materials

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Mechanically responsive crystals are expected to be applicable to actuators and soft robots.[1,2] In the past two decades, many photomechanical crystals have been developed based on photoisomerization[3] and the photothermal effect.[4] However, previously reported crystal motions were mostly driven by ultraviolet (UV) and visible light irradiation,[2] and near-infrared (NIR) light-induced crystal actuation has not been reported. Here we have achieved that the *p*-chlorosalicylideneaniline (enol-**1**) crystals[5] exhibit bending behavior using UV, visible, and NIR light, by coating the photothermal conversion material $Ti_3C_2T_x$.[6]

$Ti_3C_2T_x$ was coated only on the top surface of crystals by $Ti_3C_2T_x$ solution drop-casting (Fig. 1a). Comparing to the pristine enol-**1** crystal absorption spectrum (blue, Fig. 1b), the fully $Ti_3C_2T_x$-coated crystal had the large and broad absorption in visible and NIR region (red, Fig. 1b). Upon UV (365 nm), blue (455 nm), red (660 nm) and NIR (810 nm) light irradiation to the top surface of the fully $Ti_3C_2T_x$-coated crystal (7560 × 914 × 256 μm^3) at the same intensity (200 mW cm^{-2}), all the wavelengths could induce bend-down motion by the photothermal effect, reaching 0.8°, 0.6°, 0.7° and 0.8° in 10 s, respectively (Fig. 1c). Surprisingly, when the crystal was flipped over, the crystal exhibited the bend-up motion by red and NIR light irradiation (Fig. 1d). Finally, the difference of bending behavior among four wavelengths was successfully simulated in both non-flipped and flipped states.

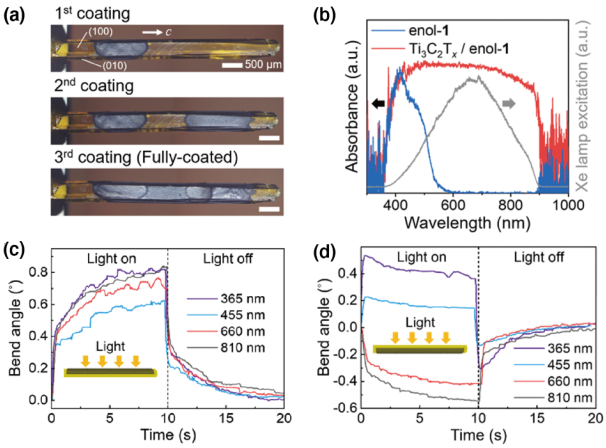

Fig. 1 (a) The coating process of the Ti3C2Tx on the enol-**1** crystal by three-step $Ti_3C_2T_x$ nanosheet solution drop-casting. (b) Absorption spectra of the pristine enol-**1** crystal and the $Ti_3C_2T_x$-coated enol-**1** crystal under excitation with Xenon (Xe) lamp light. (c, d) Time profiles of bend angles of the $Ti_3C_2T_x$-coated enol-**1** crystal in non-flipped (c) and flipped (d) states.

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