Development of Visible-Light Photomeltable Azobenzenes and Their Application as Solar Thermal Fuels

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Photomelting (photochemically-induced isothermal solid-liquid transition) is a chemical process during which photochemical reaction on solid material results in product that have liquid phase. Azobenzene is a versatile photoswitch that can undergo reversible trans to cis isomerization upon irradiation, some of its derivatives exhibit photomelting behavior. Recently, photomeltable materials gain attention from solar thermal fuel (STF, Fig. 1b) field. In addition to eliminating the needs for solvent, photomeltable materials have another advantage to be used as STF, as energy released during discharging state is a combination between isomerization enthalpy and recrystallization latent heat (Fig. 1a)[1,2]. However, ultraviolet (UV) light is still mostly used to induce photomelting.[3] This limits the usability of photomelting-driven materials, because UV only makes a small fraction of the sunlight spectrum. Here we wish to report novel visible-light driven photomeltable azobenzenes with potential application as STF.

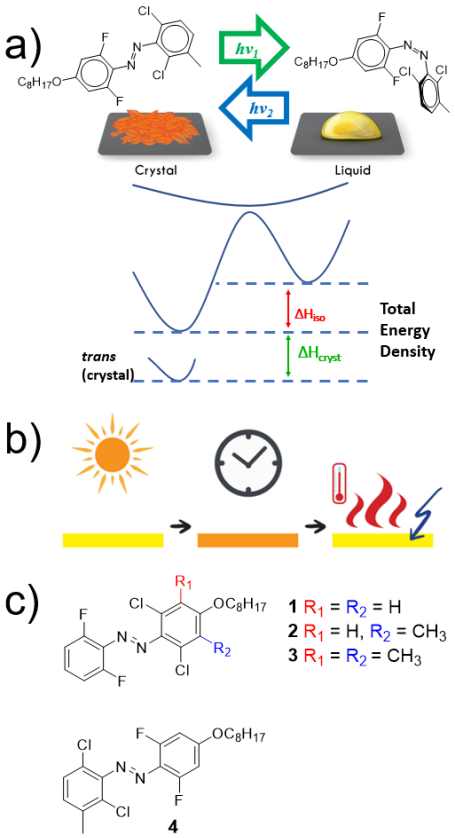

Fig. 1 (a) Schematic diagram of an azobenzene derivative photomelting and photoisomerization energy landscape. (b) Conceptual image of STF (c) Molecular structure of discussed compounds

We synthesized several visible-light responsive azobenzene derivatives **1-4** (Fig. 1c) with two *ortho*-fluorine and two *ortho*-chlorine at different rings bearing *para*-octyloxy chain and they are confirmed to photomelt. All the compounds have a relatively stable *cis* isomer, with lifetime at 30°C ranging from 43.0-117.2 days, making them potentially suitable for STF application.

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