Molecular Engineering of Single-crystal Optical Actuators

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Crystalline materials that behave as optical actuators and proceed via some form of solid-state optical switching or nano-optomechanical mechanism are of interest given their wide-ranging applications from light-driven molecular rotors,[1] photocatalysts,[2] protein nanovalves,[3] optical data storage,[4] to quantum computing.[5] Nonetheless, the field is facing a dearth of suitable functional materials for applications. One possible material option is a series of compounds based on the generic formula, [Ru(SO2)(NH3)4X]Y, whose SO2 group manifests solid-state linkage photo-isomerization (X is the trans-ligand to SO2; Y is a counterion). This light-induced phenomenon causes these materials to act as photo-induced molecular switches [6-12] or molecular transducers [13-17]. This talk will present the development of this family of materials towards such applications, via a range of advanced in situ light-induced x-ray diffraction (now known as photo-crystallography)[18-20] and in-situ light-induced single-crystal optical absorption spectroscopy microscopy experiments[11] that capture the phenomenon in their light-induced state [13-15]. Results are enabling our understanding of the light-induced molecular structure and physical properties of these light-induced solid-state actuators. Establishing this knowledge-base of structure-to-function relationships leads to the ultimate goal of being able to molecularly engineer these materials for a given device application.

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