Light-Triggered Molecular Devices: from a Drawing Board to Functional Prototypes

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Representing a unique class of smart materials, regular two-dimensional (2-D) arrays made of stimuli-responsive molecules can be used in a wide range of applications.[1] These arrays (or films) have been shown to modulate the physical properties of surfaces such as wettability, surface tension, etc. The molecules that form these films usually consist of a photoswitch connected by a linker to an anchoring group(s). Photoswitches are freely transferable between various surfaces. However, the structures of the linkers and anchoring groups must be fine-tuned to fulfill the specific needs of the individual substrates (e.g., metallic vs non-metallic, solid vs liquid, etc.). Designing molecules of this kind is a challenging task that requires careful consideration of intermolecular spacing, the characteristics of the spacer and anchoring units, and the distance of the photoswitch from the surface.

Two conceptually different approaches to such assemblies will be discussed during this talk. The Langmuir-Blodgett films made from well-organized and densely-packed monolayers consisting of two different types of photoswitches may serve as the first example. Careful selection of individual chromophores allowed us to selectively target on the layers made of the same type of photoswitches and trigger their photoresponse just by using the properly chosen monochromatic light (Figure 1A). Second approach involves the mechanochemical anchoring of rigid rod-shaped molecules on flat crystal facets of a porous, organic, zeolite-like matrix. Molecular guests featuring bulky stoppers incorporated within their structures have been developed to prevent molecules from being completely inserted into the matrix, thus ensuring the formation of surface inclusions. Intermolecular spacing between surface-mounted molecular rotors, motors,[2] and switches[3] is purely dictated by the geometry of the matrix (Figure 1B).

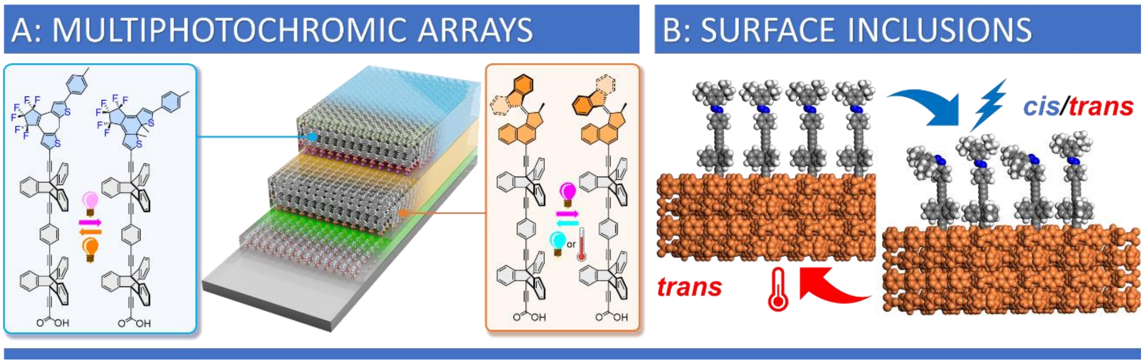

Figure 1. Graphical visualization of: (A) a bilayer system made of two different types of photoswitches and (B) photoswitchable surface of azobenzenes anchored on flat crystal facets of porous matrix.

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