Electrochemically Induced Ring-Closing and Ring-Opening Reactions of Photochromic Dithienylalkenes

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Just like their macroscopic counterparts, molecular-scale machines will require controllable moving parts, and molecular electronics will require circuit breakers and mechanisms for storing and processing information. The use of photochromic compounds (those that reversibly convert between two colored isomers in response to irradiation with specific frequencies of light) is one approach for adding such control mechanisms to molecular systems and rendering them as simple machines or circuits. Few photochromic compounds possess the favorable properties displayed by the 1,2-dithienylcyclopentene skeleton, which interconverts between its colorless ring-open and colored ring-closed isomers with a high level of fatigue resistance and bistability.

This talk will discuss the significant discovery that several derivatives of this photochromic compound are also electrochromic. In the cases where aryl rings are attached onto the 2-position of the thiophenes (Figure 1), the ring-closed forms rapidly return to their ring-open forms when electrochemically oxidized. Also, the electrochemical ring-opening process is catalytic. Only a small fraction of the ring-closed form present in solution is required to undergo the redox process in order to completely drive the ring-opening reaction. This is due to the existence of an oxidation/ring-open/reduction cycle, which eventually results in the complete conversion of all of the ring-closed form to the ring-open form. On the other hand, when methyl groups are on the 2-position of the thiophenes (Figure 2), electrochemical oxidation induces the ring-closing reaction. The significance of both processes to electrochromic displays and filters will be discussed.

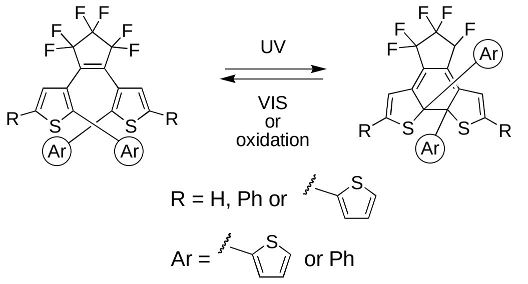

Figure 1. The electrochemical ring-opening reaction of 2-aryl-substituted 1,2-dithienylcyclopentenes.

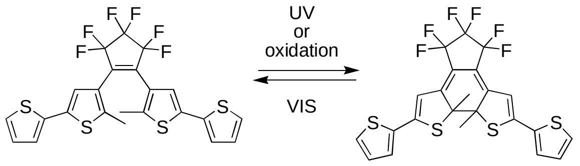

Figure 2. The electrochemical ring-closing reaction of 2-methyl-substituted 1,2-dithienylcyclopentenes.