

RING OPENING AND CLOSURE REACTION DYNAMICS OF A PHOTOCHROMIC DIARYLETHENE MOLECULE IN SOLUTION

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Diarylethene derivatives have received much attention as one of the most promising photochromic materials for the application in optoelectronic devices such as optical memories and switches because of their thermal stability and resistance to fatigue. The dynamics of cyclization and cycloreversion reactions have been studied by pico- and femtosecond transient absorption (TA). However, the reaction rate is still in controversy due to the ambiguity in TA analysis. In this work, we have measured femtosecond time-resolved spontaneous emission by up-conversion technique as well as pump/super continuum probe TA to study the ring opening and closure reaction dynamics of a diarylethene derivative 2,3-bis(2-methylbenzo[*b*]thiophen-3-yl)hexafluorocyclopentene (BTF6).

The TA signal near the absorption maximum at 530 nm, TA signal at 710 nm, where the excited state absorption is maximum, and time-resolved fluorescence give rise to identical biexponential time profiles with 4.7 and 22 ps time constants without signal induction time. The signals also reveal a 66 cm⁻¹ oscillation due to the wave packet motion in the excited electronic state where the photochromic reactions occurs. All of the experimental results and the reaction quantum yield measurement lead to the conclusion that the reaction proceeds by 22 ps time scale via curve crossing from the initially prepared Franck-Condon region. It is speculated that the 66 cm⁻¹ vibrational mode is likely to be involved with the reaction coordinate.