Cis-Trans isomerization of Methyl Red in 1-Octanol studied by pump-probe spectroscopy

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The phenomenon of photo-induced and/or thermally induced Cis-Trans isomerization (CTIS) of Azo dye molecules has been attracted much attention in the viewpoints of the basic science and the possibility of photo-reactive molecular device application. However, in spite of the potential ability of Azo dyes, it seems that only a few studies have been reported for the dye concentration dependence of CTIS process [1,2].

Here, we report the study of the concentration dependence of thermally induced CTIS rate of Methyl Red (MR) in 1-Octanol by pump (532nm)-probe (488nm) spectroscopy. The experimentally obtained CTIS rate is shown in Figure. The CTIS rate $k$ showed a MR concentration dependence below $\sim 6 \times 10^{-5}$ mol/L. Above $\sim 6 \times 10^{-5}$ mol/L, however, we observed a constant CTIS rate. As far as we know, this constant CTIS rate has not been reported so far. The CTIS process of MR is caused through the rotation about the $-N=\equiv N-$ bond [2]. The CTIS rate proportional to the dye concentration has been explained for MR by the formation of the dimer [1].

In the dimer form, the positively charged $H^+\delta^+$ ion of a MR induces the $-N=\equiv N-$ bond of the other MR to change $-N-\equiv N-$, and the MR easily rotates to transit Trans state. We interpreted the constant CTIS rate to be the result of the trimerization. The motion of the center MR of the three sequences of the MR’s is restricted mechanically, and only one MR can isomerize easily. Thus, at high MR dye concentrations, CTIS rate is constant.
