

Ultrafast Ground State Recovery Dynamics of a Cyanine Dye Molecule in Heterogeneous Environment

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Abstract : We have studied the changes in ground state recovery dynamics of IR 144 dye using degenerate transient absorption spectroscopy technique when going from homogeneous solution phase to heterogeneous partially miscible liquid/liquid interface. Towards this aim, we set up a partially miscible liquid/liquid interface in which dye is insoluble in one solvent carbon tetrachloride (CCl₄) layer and soluble in other solvent dimethyl sulphoxide (DMSO). A gradual increase in ground state recovery time of the dye molecule is observed from homogenous bulk solution to more heterogeneous environment interface layer. In the bulk solution charge distribution of dye molecule is in equilibrium with polar DMSO solvent molecule. Near the interface micro transportation of non-polar solvent, CCl₄ disturbs the solvent equilibrium in DMSO layer and it relaxes to a new equilibrium state corresponding to a new charge distribution of dye with a heterogeneous mixture of polar and non-polar solvent. In this experiment, we have measured the time required for the dye molecule to relax to the new equilibrium state in different heterogeneous environment. As a result, dye remains longer time in the excited state such that even it can populate more triplet state. The present study of ground state recovery dynamics of a cyanine dye molecule in different solvent environment provides the important characteristics of effect of solvation on excited life time of a dye molecule.

Keywords : excited state, ground state recovery, solvation, transient absorption

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