ULTRAFAST SPECTROSCOPY OF METHYL VIOLOGEN: EFFECTS OF ZEOLITE ENTRAPMENT

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Bipyridinium compounds are attractive electron relay agents that can be easily incorporated into zeolite voids by ion exchange. By preparing zeolite particles of colloidal size, we have been able to suppress light scattering and greatly improve the optical properties of zeolite nanoparticles suspended in various solvents. With these systems, femtosecond transient absorption signals can be recorded in a conventional transmission geometry with high signal-to-noise ratios. The extreme sensitivity of methyl viologen (1,1´-dimethyl-4,4´-bipyridinium) excited-state dynamics to the solvent in homogeneous solution makes this molecule an excellent probe of the microenvironment within zeolite cavities. Steady-state excitation and emission spectra of zeolite-entrapped viologens exhibit spectral shifts. Additionally, time-resolved measurements reveal how impediments to molecular motion by the viologen and entrapped solvent molecules affect radiative and nonradiative decay. We report that the entrapped viologens experience lifetimes similar to those in bulk solvent in addition to a new decay pathway that is indicative of a direct effect of the zeolite on the excited viologen. These results are helping to explain the static and dynamical factors that modulate charge separation, propagation, and recombination within zeolite membranes.