Solvation Dynamics of Coumarin 153 in Binary Solvents

Coumarin 153 (C153) is a prototypical molecular probe used in the determination of solvation dynamics because of its notable sensitivity to solvent environment. The luminescence properties and excited-state lifetime of this hydrophobic optical dye make it amenable to photon counting measurements. Moreover, C153 has been used extensively in the characterization of solvation and rotation dynamics of room-temperature ionic liquids (ILs). However, one of the problems with many ILs is that they readily absorb water and this exacerbates solution preparation due to air exposure. Additionally, ILs are often combined with an organic cosolvent to tailor the IL solution properties. Often, these organic solvents can contain significant amounts of water or are notoriously hygroscopic. The goal of this work is to characterize the impact of water on the solvation dynamics in using organic solvents that are commonly paired with ILs. C153 solvation in acetonitrile (ACN)/water and dimethylsulfoxide (DMSO)/water mixtures was determined by calculating the time dependent Stokes shift as a function of water mole fraction. The composition dependent solvation times typically follow solution viscosity. The magnitude of the dynamic Stokes shift is similar in both ACN/water and DMSO/water varies from ~ 50 – 400 cm$^{-1}$ as water mole fraction varies from 0 to 1. Solvation times are less than 500 ps in both systems.