Abstract of the thesis

Title of thesis: Photophysical and photochemical studies of the interactions among molecules with chemical and biological significance

The objective of the thesis is to sightsee various facets of electronic spectroscopy with the photophysical exploration of some well-known, as well as newly synthesized molecules in solution phase, and also their interactions with other small molecules and biological macromolecules. The emissive properties of 1-Keto-1,2,3,4-tetrahydrocabazole (KTHC) derivatives DMTCO, MDDCO and TDCO are considerably solvent sensitive, although their absorption spectra are relatively less sensitive to the nature of the solvents. Various analyses suggest that the hydrogen bond donating ability of the solvents is primarily important in controlling the fluorescence spectral shifts of the KTHC-derivatives. The excited state properties of DMTCO, MDDCO and TDCO are influenced by the presence of aromatic amines DMA and DEA, due to the occurrences of photoinduced electron transfer from the amines to the KTHC-derivatives. The emissive properties of KTHC-derivatives KTHC-67 and MOTHCA are modified in presence of β-cyclodextrin, due to the formation of inclusion complexes. Photophysics of 1,8-naphthalic anhydride (NAN) in aprotic solvents reveal that their excited state properties are solvent sensitive, especially to the proton affinity of the solvents. Photoinduced electron transfer from the aliphatic amines TEA, TBA and DIEA to NAN affects the excited state properties of NAN. The different handedness of R- and S-BINOL is responsible for their differing modes of interaction with the model transport protein HSA. S-BINOL in its binding site can form hydrogen bond with neighboring residue Tyr138, followed by photoinduced proton transfer and the formation of the corresponding anion. No such change is observed with R-BINOL. As a consequence, even nanomolar concentration of S-BINOL is capable to transform the secondary structure of the protein from partial to totally helical and accordingly imparts enhanced stability to HSA compared to R-BINOL. A better understanding of the photophysical properties of molecules and the various photoinduced phenomena is required for finding suitable usage of the molecules in analytical, biological, therapeutical or industrial fields. Such basic experiments are the precursors of much more complicated studies, which would be relevant for the abovementioned different fields.

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