ABSTRACT OF THE THESIS

“Synthesis and Photophysical Studies on Fluorescent Analogs of Some Biologically Relevant Compounds and Conjugated Polymers”

Submitted by
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My thesis principally deals with the photophysics of two important classes of fluorophores:

i) Fluorescent analogs of some biologically relevant compounds

ii) Fluorescent Conjugated Polymers

Structural variations in fluorophores often modify their spectral properties significantly, which enriches our understanding of their photophysics. The thesis therefore includes an elaborate synthesis program to help us realize structural variations not explored before.

As biologically relevant compounds, we chose the Photoactive Yellow Protein (PYP) Fluorophore and Pterins. PYP plays a key photo-transduction role in certain bacteria, which is controlled by the photophysics of its Fluorophore lodged inside the protein interior. In our work, we synthesized structural analogs of this Fluorophore and studied their fluorescence in both bulk solutions as well as inside the confined environments of supramolecular assemblies.

Pterins are ubiquitous as components of many naturally occurring biological systems. Although they usually do not perform explicitly photo-driven functions in nature, still their photophysical studies reveal the molecular electronic dynamic processes behind their functional role. Photophysics of pterins have been studied so far only in bulk aqueous solutions. However this limits our understanding, since in nature, they are generally found in cell organelles and membranes, where the local environment is very different. Therefore, in our work, we have extended the scope of pterin photophysics into non-aqueous polar solutions as well as in reverse micelle systems.

As fluorescent conjugated polymer, we have chosen poly(phenylenevinylene) or PPV, which has novel optoelectronic properties like conductivity and fluorescence. But pure PPV is insoluble, hindering its utilization. We have used two soluble PPV derivatives: mehPPV and mcpPPV. Of them, mcpPPV is soluble in water, which makes it suitable for application in aqueous environments like biological systems. Moreover, mcpPPV behaves as a polyelectrolyte in alkaline pH conditions. For both the derivatives, we found that the solution photophysics can be interpreted mainly in terms of the conformational state of the polymer, which again depends on whether the solvent behaves as a good solvent or a poor solvent. Time-resolved studies indicated the presence of two emissive species for mcpPPV in several non-aqueous solvents.

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