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## Photophysics and photochemistry of mercurochrome in reverse micelles



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### ABSTRACT

The photophysics of the xanthene dye 2',7'-Dibromo-5'-(hydroxymercurio)fluorescein disodium salt (merbromine, mercurochrome) (Mcr) was studied in reverse micelles (RMs) of sodium 1,4-bis (2-ethylhexyl) sulfosuccinate (AOT) and benzylhexadecyldimethylammonium chloride (BHDC). In the reverse micellar media both the absorption and emission spectra of the dye present a red shift with respect to water. It is concluded that MCr in both reverse micellar systems is localized in the interface. In BHDC due to the positive charge at the interface and the negative charge of the dye, it remains anchored to the interface irrespective of the water content of the RMs. On the other hand in the case of the negative interface of AOT the photophysical properties tend to those in homogeneous water solution as the water content increases. For small size AOT RMs the dye resides in the interface co-micellizing with the surfactant, although more exposed to water than in the case of BHDC. Special interest was assigned to the effect of confinement on the triplet state properties. The triplet state decay kinetics and absorption spectra were determined by laser flash photolysis. The triplet lives longer in RMs than in homogeneous solvents. The compartmentalization of the dye precludes the auto-quenching which shorts the lifetime in homogeneous solvents. Furthermore, the quenching by electron donors and acceptors was investigated. Two aliphatic amines were used as electron donors. The hydrophilic triethanolamine (TEOA) is localized in the water pool, and the triplet quenching is more efficient than in homogeneous solvents. The apparent quenching rate constant for TEOA in AOT is one order of magnitude higher than BHDC. On the other hand the quenching by dipropylamine (DPA) which is located in the bulk organic solvent is much less efficient. The quenching by TEOA in RMs can be understood in terms of an exchange mechanism between micelles. As electron acceptor 1,4-benzoquinone (BQ) was employed, and the value in BHDC is two orders of magnitude higher than in AOT. These divergences most likely arise from different partitions of the quenchers in the reverse micellar systems.

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### 1. Introduction

Reverse micelles (RMs) are frequently considered as self-organized nano-reactors. In these systems, the reactants are confined within a small region, a few nanometers in size, and the reactivity and products properties of different processes may differ dramatically from those in homogeneous solutions. In the interior of RMs the local properties like polarity, viscosity and pH are vastly different from those in homogeneous medium [1]. Consequently, the physical and chemical properties of confined molecules may undergo dramatic changes in these systems. These changes are also useful to characterize the so-called microenvironmental

properties, including local polarity (micropolarity) and local viscosity (microviscosity) of micellar systems. The photophysics of dyes provides a useful tool for investigate these properties [2] and the information gained in this way is very important from both an applied and a fundamental point of view [3]. For example, these studies are of interest with regard to micellar systems as a reaction medium because they affect both the kinetics and the mechanism of a specific reaction [4,5]. They are as well important in many applications of electronic energy transfer, which may include photosensitized reactions and the micelle enhanced emission detection in analytical techniques [6]. In these systems donor, acceptor and micelle concentrations may be high enough to allow considerable energy transport between neighboring micelles. On the other hand, the understanding of the interactions between ionic dyes and charged surfaces is of interest in numerous applications ranging from the design of electronic devices to the

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