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Shuttling of Drugs in Ionic Liquid-Water Biphasic System

Asima Monjur[1], Md. Abu Bin Hasan Susan[1,2]*
[1] Department of Chemistry, University of Dhaka, Dhaka-1000, Bangladesh
[2] Dhaka University Nanotechnology Centre, University of Dhaka, Dhaka-1000, Bangladesh
* Corresponding Author's Email: susan@du.ac.bd

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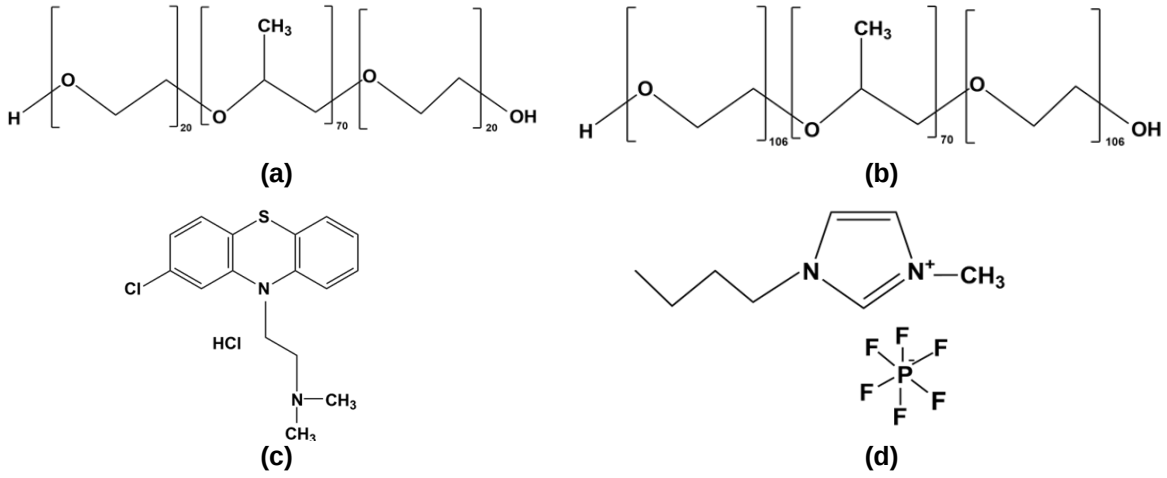
Extended Abstract

The selective aggregation behavior of amphiphilic molecules is of immense interest in developing smart material system based on supramolecular host-guest architecture. The systems are actively investigated mostly as extraction media for insoluble organic products [1], drug delivery system, nanoreactors, and so on. Apparently, block copolymers containing poly(ethylene) (PEO) and poly(propylene) (PPO) blocks have thermosensitive characteristics [2]. In this work, solution behavior of triblock copolymers (Pluronic P123 and F127) are studied in aqueous and an hydrophobic ionic liquid (IL), 1-butyl-3-methylimidazolium hexafluorophosphate [C_4mim]PF_6 (Scheme 1).



Scheme 1: Structure of materials used (a) Pluronic P123, (b) Pluronic F127, (c) Chlorpromazine, and (d)1-butyl-3-methylimidazolium hexafluorophosphate.

The temperature-dependent aggregation behavior has been studied using dynamic light scattering up to 65 °C. The hydrodynamic diameters of Pluronic was found to increase linearly with temperature from (~10-30 nm) in IL with a sudden drop at ca. 45 °C in aqueous phase. The different LCST behavior of the poly(ethylene) block in water and ionic liquid gave a notion that the aggregates formed by the surfactants may act as a carrier of drug; that is to be switched in the biphasic system under thermal perturbation.

The interaction of another amphiphilic drug chlorpromazine is also manifested in the aggregation behavior. Chlorpromazine itself can act as a molecular probe. The redox reaction of the probe is a one electron process at neutral pH and follow simple heterogeneous kinetics at low scan rates. The concept of electrochemical switching was applied to transfer the drug from one phase to another based on the accumulation and depletion of charge from the micellar core of the Pluronic. The successful thermal switching was observed at temperature of 60 °C using P123 as the carrier of the drug (Fig. 1).

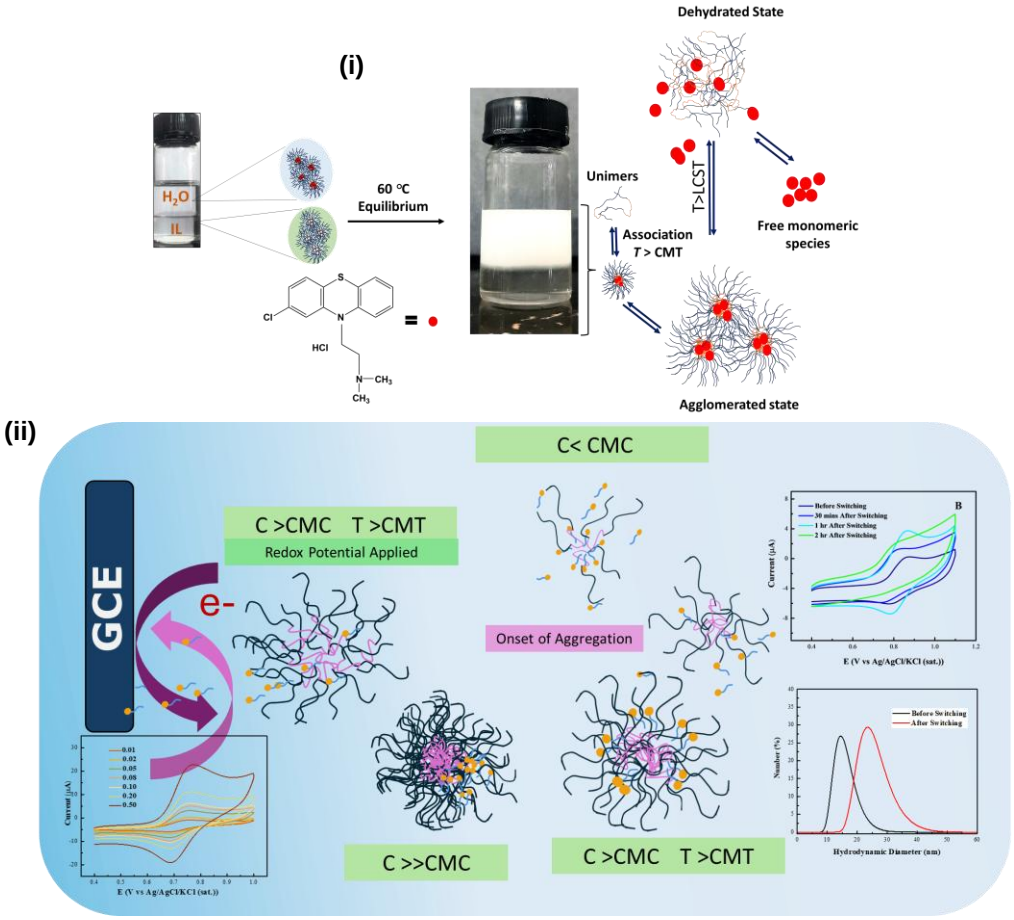


Figure 1: Tentative illustration of molecular events occurring during (i) thermal switching and (ii) electrochemical switching.

The successful switching is ascertained from the increment of hydrodynamic diameter, scattering light intensity and change of the reduction current in aqueous phase. The study can be regarded as an initiation to unlock the potential of micellar shuttle as a switching system used for delivering hydrophobic drugs from aqueous to hydrophobic environment.

References

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