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Micelles as containers for self-assembled nanodevices
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We are working to a new approach in micellar chemistry, using micelles as nanosized containers to self-assemble multicomponent molecular devices that display new functions, useful in the field of medicinal chemistry and drug delivery. We use micellar aggregates that have an approximately spherical shape, with a diameter < 10 nm and a volume of less than 500 nm^3. Inclusion of different molecular species in these containers may be obtained simply by tuning overall concentrations, provided that the molecular components are intrinsically lipophilic or lipophilized on purpose. Micellar inclusion dramatically increases local concentrations and dehydrates the included molecules, thus promoting their interactions that can be dynamic, as the viscosity inside a micelle is comparable to that of an organic solvent droplet. With this approach selective fluorescent sensors for metal cations have been built, based on intramicellar electron-transfer processes. We have now made a further step forward, exploiting also the container properties and features. We have elaborated a multicomponent nanosized device capable of evaluating the lipophilicity of a chosen molecule and reporting it with an intense fluorescent signal, taking advantage of the capability of the micellar/water interface to select the entrance of molecules in the micellar core on the basis of their lipophilicity. This is of particular interest if it is remembered that evaluation of lipophilicity is a very important step in profiling drug-like properties of new molecules for their medical use, in particular as regards oral absorption and brain uptake,[2] and micelles offer an interface with water that mimics that of a cellular membrane. Moreover, considering that most of the biologically important processes take place only inside narrow windows of concentration of H^+, we have also built a micellar device capable of signalling with fluorescence if the pH of a solution is inside a window, whose width and position along the pH axis can be chosen at will, thanks to the comicellization of non-ionic and ionic surfactants, that is capable of regulating the overall charge of the container and to finely tune the pH of switch of micellized quenchers.

References

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