

Solvatochromism and cluster formation in solutions of fullerene C₆₀

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The relation of solvatochromism with the appearance, growth and reorganization of fullerene clusters in C₆₀ solutions under different conditions has been actively discussed in the last decade (e.g., see review [1]). The present report summarizes the results on this question basing on the data of a number of methods including various types of spectroscopy, dynamic light scattering, extraction, small-angle neutron scattering, mass spectrometry, and others. For the most part, it concerns rather polar solvents (with dielectric constant ε above 10) such as pyridine with $\varepsilon = 12.5$ or N-methyl-2-pyrrolidone (NMP) with $\varepsilon = 32.2$, where the so-called temporal solvatochromism (time evolution of UV-Vis spectrum) is accompanied by the formation of large (characteristic size of more than 100 nm) but stable (years) fullerene clusters. Along with sharp changes in the absorption characteristics after a new solvent (polar or non-polar) is added to such a solution, some cluster reorganization is observed as well. It is difficult, however, to establish a direct relationship between two effects. The reason is a significant influence of the solvent-solute interaction resulting in specific donor-acceptor complexes. As it has been recently shown [2,3], in addition to the dependence on fullerene concentration [4], the complex formation changes in time, thus contributing to the temporal solvatochromism. Such complexes can be responsible for the long-term cluster stabilization. They also increase the solvation rate of highly polar solvents (e.g. water with $\varepsilon = 80$, where C₆₀ is totally insoluble) with respect to fullerene, which causes partial cluster dissolution on addition of these solvents to fullerene solutions. So, the processes reflected in the discussed solvatochromic effects are a significant part of somewhat a transition from the molecular to colloidal states of fullerene in polar solvents, the origin of which is still to be clarified.

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