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**Temporal solvatochromic effect in ternary C<sub>70</sub>/toluene/N-methyl-pyrrolidine-2-one solution**

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**Abstract**

The temporal solvatochromic effect in the C<sub>70</sub>/toluene solution with 20 vol. % of N-methyl-pyrrolidine-2-one (NMP) was observed and investigated by UV-Vis spectroscopy. The structure of the C<sub>70</sub> aggregates in this mixture was measured by small-angle X-ray and dynamic light scattering methods applied to the “old” solutions. The performed structural investigations reveal the existence of a prevailing concentration of small fullerene clusters. As the result, it is supposed that the observed solvatochromism is caused by the formation of charge-transfer complexes between fullerene and NMP molecules.

Keywords: fullerene; solvatochromic effect; UV-Vis spectroscopy; small-angle X-Ray scattering; dynamic light scattering.

**1. Introduction**

Since fullerenes were discovered and especially in the last decades, potential applications of fullerene solutions in various fields including electronics, optics, cosmetics, and pharmaceuticals were intensively studied [1-3]. For the isolation of fullerenes from carbon soot [4], the separation of C<sub>60</sub>/C<sub>70</sub> mixtures [5] and the preparation of fullerene aqueous solutions by solvent-exchange method [6] the organic solvents like toluene, N-methyl-pyrrolidine-2-one (NMP) and benzene widely are used. The penetration of these materials into the environment requires accurate characterization of physicochemical properties of the fullerene solutions. Despite numerous papers devoted to fullerene dispersions, which was detailed in recently review [7] the behavior of fullerenes at the transition from an organic solvent to a polar environment is still unclear. Solutions of the fullerenes C<sub>60</sub> and C<sub>70</sub> in polar and non-polar solvents and their mixtures are characterized by various effects, such as the unexpected aggregation in solvents with good fullerene solubility, or solvatochromic effects in solvent mixtures [8-10]. Recently, the solvatochromic effect caused by variation of the dielectric constant in solvent mixtures [11] or by an increase in the fullerene concentration [12] was discovered.

The temporal solvatochromic effect can be identified by the increasing of light absorption (hyperchromic effect) and by the smoothening of UV-Vis absorption spectrum. Fullerenes aggregation in polar/non-polar liquid mixtures is sometimes considered as one of the factors that cause a solvatochromic effect. Indeed, the use of ultrasound or intense mixing at the solution preparation, an increase in the fraction of the polar solvent, poorly dissolving fullerene (e.g. alcohols) in a mixture approaches to the supersaturation of the system [7,13]. This leads to fullerene aggregation and potentially to further precipitation. However, in case of mixtures where the polar component dissolves fullerenes quite well (i.e. pyridine, NMP) a solvatochromic

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