Diffusion of fullerene C60 Diluted in Toluene and Tetralin

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Fullerenes play a significant role for potential use in medicine, especially as drug delivery systems to transport active products towards pathological sites or even capture molecules in their cage. There are different types of fullerenes, but the most common and extremely stable one is C60. For most applications, it is necessary to create fullerene derivatives, which contain additional functional units on the outer part of the spheres. The knowledge of the transport properties of fullerene and its compounds in various organic and biological solvents is important for applications. However, such experiments are rare.

Here, we present experiments on binary fullerene solutions in two organic solvents, 1,2,3,4-tetrahydronaphthalene and toluene and compare these measurements with the respective properties of the binary mixture of the pure solvents. The transport properties of three selected solutions were measured by five individual instruments, different by the operation principle (convectionless Soret and diffusion cells, and convection-assisted thermogravitational columns), and by the diagnostics (sampling, and non-intrusive optical sensing). In general, all techniques provided consistent results in a good agreement with each other.

The values of diffusion coefficients are within the range typical for molecular mixtures, and allowed us to conclude about absence of fullerene aggregation in the studied mixtures. The thermodiffusion coefficients, however, are an order of magnitude higher than those of conventional mixtures, which makes it possible to classify fullerene solutions as colloids/nanofluids, at least with respect to the thermophoretic transport.

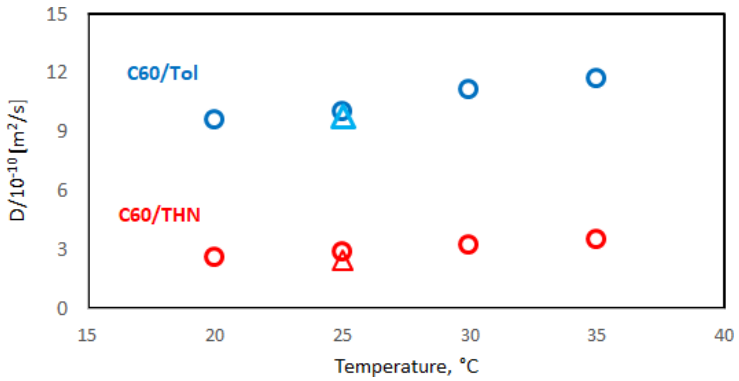

Fig. 1: Dependence of the C60/THN(0.0012/0.9988) and C60/Tol(0.0018/0.9982) Fick diffusion coefficient on temperature measured by the Beam Deflection technique [1] (circles) and Sliding Symmetric Tubes technique[2] (triangles)

References

[1] Königer, A.; Wunderlich, H.; Köhler, W. *Measurement of diffusion and thermal diffusion in ternary fluid mixtures using a two-color optical beam deflection technique*. J. Chem. Phys. 2010, 132, 174506.

[2] Larranaga, M.; Rees, D. A. S.; Bou-Ali, M. M. *Determination of the molecular diffusion coefficients in ternary mixtures by the sliding symmetric tubes technique*. J. Chem. Phys. 2014, 140, 054201.