Thermal transport of lyophilized nanoparticles in porous media

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Many potential biomedical applications of nanocolloids, and specifically ferrofluids, (magnetic hyperthermia, drug targeting, nanoparticles as therapeutic agents) deal with nanoparticle transport in porous environments, often in non-isothermal conditions. The presented work deals with peculiarities of thermophoretic transport of surfaced nanoparticles in a porous material, with particular attention paid to presence of organic acid molecules, both in particle surfactant layer and as excess ingredient in carrier fluid.

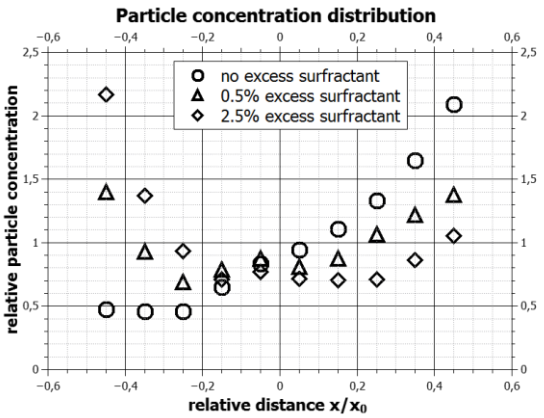

Fig.1. Nanoparticle concentration profiles at various concentrations of surfactant.

Our earlier experiments have shown [1] an unexpected decrease of Soret coefficient for surfaced ferrocolloids in a porous environment. We propose that a reason of that might be closely related to thermoosmotic phenomena described in [2]: beside the slip velocity that drives the particle in a colloid toward decreasing temperature there also appears a slip velocity on pore surfaces which induces an advective particle flux in opposite direction. In order to investigate this assumption we have performed experiments by varying the excess of free surfactant in carrier liquid thereby changing the Gibbs adsorption energy on pore surfaces that is responsible for the thermoosmotic flux velocity in pores. Experimental results (Fig. 1) seem to support the proposed transport mechanism, relating reduction of thermodiffusive nanoparticle transport to increasing concentration of organic acid surfactant.

References

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2. J. L. Anderson, Ann. Rev. Fluid Mech. **21** , 61-99 (1989) .

The work is supported by the Latvian State Research Program IMIS[2].