

THERMOPHORESIS IN COLLOIDAL SUSPENSIONS

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The presence of a thermal gradient in a fluid mixture induces a relative matter flow of the components known as thermal diffusion or Soret effect, which plays a crucial role in many naturally occurring processes, and set the scene for giant fluctuations in non-isothermal mixtures [1]. Thermophoresis, consisting in the drift of dispersed particles due to a thermal gradient, is the counterpart of the Soret effect in macromolecular solutions or colloidal suspensions. Recent experiments on DNA solutions have shown that polymer thermophoresis may lead amplification up to a thousand fold of the local macromolecular concentration [2]. So far, thermophoresis still lacks any general microscopic picture: for instance, in most cases disperse particles migrate to the cold, displaying a “thermophobic” behavior. However, examples of “thermophilic” motion (diffusion to the hot side) have frequently been reported. By measuring the Soret coefficient S_T of charged SDS micelles, we have recently investigated charge contributions to thermal diffusion, showing that electrostatic interactions play a crucial role in thermophoresis [3]. In the single-particle regime, S_T grows as the square of the Debye-Hückel length. Yet, collective effects yields a full reversed situation even at very low c . Single particle behavior and collective contributions can be understood in terms of a “microscopic Marangoni effect”, originally proposed by Ruckenstein [4], relating thermophoresis to particle-solvent interfacial tension gradients. This approach can be generalized to other disperse systems showing different particle solvation. We shall present results relative to other complex fluids and diperse systems, ranging from proteins near crystallisation [5] to flexible polyelectrolytes and latex suspensions, showing that the Soret coefficient can be carefully tuned in amplitude and even in sign by controlling solvent-particle interactions.

[1] J. V. Tyrrell, *'Diffusion and Heat Flow in Liquids'*, Butterworths, London (1961)

[2] D. Braun and A. Libschaber, *Phys. Rev. Lett.* **89**, 188103 (2002)

[3] R. Piazza and A. Guarino, *Phys. Rev. Lett.* **88**, 208302 (2002)

[4] E. Ruckenstein, *J. Colloid Interface Sci.* **83**, 77 (1981)

[5] S. Iacopini and R. Piazza, *Europhys. Lett.* **63**, 247 (2003)