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Thermophoresis a sensor for solute-water interactions

Thermophoresis or Thermodiffusion describes the mass transport in a temperature gradient. It can be used for the characterization of protein-ligand binding reactions, in devices for energy conversion and is discussed in the context of the origin-of-life question. In our studies we focus on biological and biocompatible systems. We find that the thermodiffusion in aqueous systems is dominated by contributions from heat of transfer, hydrogen bond and ionic interactions. However, the separation of these effects is often difficult, especially in case of biological systems where a systematic exclusion of contributions may not be feasible. We find that the thermodiffusion of non-ionic solutes in water is dominated by the capability of the solute to form hydrogen bonds. For these solutes we find a clear correlation with their hydrophilicity. For ionic solutes, even for simple salts the situation is more complicated. Hydrogen bonding interactions are less dominant, but we find partial agreement with the Hofmeister series, suggesting that thermodiffusion is sensitive to ion-specific effects. Beside the deficiencies of the theoretical analysis, we will also elucidate the shortcomings of the available experimental methods handling biological multicomponent systems.