Simulations of thermophoretic microswimmers

Marisol Ripoll and Mingcheng Yang
Theoretical Soft-Matter and Biophysics, Institute of Complex Systems,
Forschungszentrum Jülich, Germany

In the presence of a temperature gradient, a colloidal particle experiences a directional motion which can be oriented to the warm or to the cold areas depending on the colloid-solvent interactions [1,2,3]. This directed motion is known as thermophoresis, thermal diffusion, or Soret effect. Besides the colloidal drift, the temperature gradient also induces a flow of the surrounding solvent. This flow is responsible for example of the long-ranged hydrodynamic attraction between colloidal particles near a boundary wall, and it is the basic mechanism to fabricate new micromachines, like thermophoretic pumps [4]. Self-propelled motion can be induced for example in the cases of Janus or dimers colloidal particles with asymmetric properties [5,6]. In these cases, one half of the particle can be heated to a fixed temperature producing a radially symmetric temperature gradient. The thermophoretic properties of the other half produce then a propulsion against or towards the heated part, such that the asymmetric microparticle becomes a microswimmer. These self-propelled particles can have properties of puller, pushers or neutral swimmers. We will summarize recent investigations on these systems performed by means of a mesoscopic simulation technique known as multiparticle collision dynamics simulations (MPC) [7,8].

1. S. Wiegand, *J. Phys.: Condens. Matter*, 16, R357, (2004).
2. R. Piazza and A. Parola, *J. Phys.: Condens. Matter*, 20, 153102, (2008).
3. D. Lüsebrink, M. Yang and M. Ripoll, *J. Phys.: Condens. Matter*, 24, 284132, (2012).
4. M. Yang and M. Ripoll, *Soft Matter*, 9, 4661, (2013).
5. H. R. Jiang, N. Yoshinaga and M. Sano, *Phys. Rev. Lett.*, 105, 268302, (2010).
6. M. Yang and M. Ripoll, *Phys. Rev. E*, 84, 061401, (2011).
7. A. Malevanets and R. Kapral, *J. Chem. Phys.*, 110, 8605, (1999).
8. D. Lüsebrink and M. Ripoll, *J. Chem. Phys.*, 136, 084106, (2012).