The Role of Mass Asymmetry on the Thermal Polarization of Janus Particles

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Since the early observations of thermodifussion by Ludwig and Soret [1,2], many other interesting effects driven by thermal gradients have been uncovered, such as the thermal polarization effect [3,4]. Differences in shape, chemistry, and internal composition of colloids are key variables that drive thermal rectification of colloidal motion. For this reason, Janus particles have gained attention in the context of self-assembly[5] and active matter [6]. Theoretical work on the thermal polarization of Janus particles has focused on differences in the surface properties [7]. However, the internal mass distribution has also been shown to play a key role in the thermal orientation effect [8-10]. In this work, we show that both particle-fluid interactions, as well as mass asymmetry, need to be considered to describe the thermal response of Janus colloids in homogeneous thermal fields [11]. Mass asymmetry can lead to the enhancement or inhibition of the thermal orientation effect arising from differences in surface chemistry. Our work provides a better understanding of the behavior of Janus colloids under non-equilibrium conditions and opens new avenues for their rational design in the context of directed assembly processes.

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