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Janus-Particles in a rarefied gas: thermophoresis and orientation TOBIAS BAIER, TU Darmstadt, SAMIR SHRESTHA, Kathmandu University, SUDARSHAN TIWARI, TU Kaiserslautern, STEFFEN HARDT, TU Darmstadt, AXEL KLAR, TU Kaiserslautern — Thermophoresis, the motion of a particle along a thermal gradient, has been used both for preventing and inducing the deposition of aerosols on heated or cooled surfaces. In the latter case it may be advantageous to induce the deposition with a preferred orientation of the particle, for example by utilizing non-uniform reflective properties on the particle surface. As a model system we investigate a spherical Janus particle on which gas molecules are reflected diffusively from one hemisphere and specularly from the other. In the limit of large Knudsen number this is studied analytically, focusing on the interplay between thermophoretic motion and alignment of the particle. Without motion, a torque orients the particle with its diffuse side towards the colder gas. However, any motion of the particle relative to the gas results in a preferred alignment with the specular side in direction of the particle velocity. Thus the thermophoretic motion, which is towards the colder side, results in a weakening of the particle alignment. The results are supported by Monte-Carlo simulations to extend the range of validity towards finite Knudsen numbers. These findings shed light on the efficiency of aligned deposition of nanoparticles from a gas stream on a cooled surface.

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