Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Particle orientation during thermophoretic transport in a gas phase STEFFEN HARDT, TOBIAS BAIER, Center of Smart Interfaces, TU Darmstadt, SAMIR SHRESTHA, SUDARSHAN TIWARI, AXEL KLAR, Fachbereich Mathematik, TU Kaiserslautern — Using numerical and (semi)analytical techniques it is shown that during thermophoretic transport in a gas small particles may take a preferred orientation. For that purpose spherical model particles are considered, consisting of two hemispheres with diffuse and specular reflection boundary conditions, respectively. A Monte-Carlo method is used to simulate the translational and rotational dynamics of a particle colliding with surrounding gas molecules. The simulations show that a particle exposed to a temperature gradient takes a preferred orientation, moving through the gas with its diffusely reflecting hemisphere pointing towards the direction where the temperature is lower. In addition to that, in the free molecular flow regime the Langevin equation is used to study the rotational dynamics. In this regime it is possible to derive analytical expressions for the torque acting on the particle and for the dissipation force related to rotational motion. The stationary solution of the Langevin equation gives the probability density function for the particle orientation. The results could be of relevance for a number of processes in which nanoparticles are synthesized in a gas phase and deposited on a cold surface.

Steffen Hardt
Center of Smart Interfaces, TU Darmstadt

Date submitted: 24 Jul 2014 Electronic form version 1.4