STOCHASTIC THERMODYNAMICS OF A DRAGGED NANOCOLLOID HYDRODYNAMICALLY COUPLED TO A FLUID HEAT BATH

V. Thakore[1], C. M. Monasterio[2], H. Siikonen[1], S.T.T. Ollila[3] and Tapio Ala-Nissila[1,4]

[1]COMP Center of Excellence, Department of Applied Physics, Aalto University, Finland; [2]Laboratory of Physical Properties TAGRALIA, Technical University of Madrid, Madrid, Spain; [3]Varian Medical Systems Finland, Paciuksenkatu 21, 00270 Helsinki, Finland; [4]Department of Physics, Brown University, Providence, Rhode Island, USA
email: vaibhav.thakore@aalto.fi

Stochastic thermodynamics of mesoscale systems has been extensively studied using a dragged colloidal particle in a trap as a model system. The colloid is assumed to be a massive Brownian particle that undergoes stochastic motion governed by a Langevin-type equation. The Langevin description of the colloidal motion however completely ignores the hydrodynamic coupling of the colloid to the heat bath. Here, we present results for the stochastic thermodynamics of a dragged nanocolloid hydrodynamically coupled to a fluid heat bath. The motion of the colloidal nanoparticle is modeled using a hybrid fluctuating lattice Boltzmann (FLB) and molecular dynamics (MD) method that accounts for full nonlinear hydrodynamic effects. The mesoscopic FLB-MD method employed in our simulations for the dragged colloidal particle in a trap allows testing of the fluctuation theorems in the truly transient regime of system evolution. FLB-MD also explicitly allows a study of the irreversible work done on the colloid-solvent system in the form of heat dissipation or entropy production in the fluid that has so far been impossible to achieve even in experiments.

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