Abstract Submitted
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The Osmotic Motor UBALDO CORDOVA-FIGUEROA, JOHN F. BRADY, California Institute of Technology — We propose a model for self-propulsion of a colloidal particle – the osmotic motor – immersed in a dispersion of colloidal 'bath' particles. The osmotic motor is propelled by a chemical reaction that consumes bath particles over a portion of its surface. The non-equilibrium microstructure of bath particles induced by the surface reaction creates an 'osmotic pressure' imbalance on the motor's surface causing it to move to regions of lower bath particle concentration. The osmotic motor's behavior is calculated for two scenarios: one in which the motor is held fixed and a second where it is free to move. The departure of the bath particle concentration from equilibrium is characterized by the Damköhler number Da: the ratio between the surface reaction velocity and the diffusion velocity. The computed microstructure is employed to calculate the driving force of the motor, from which the self-induced osmotic velocity is determined via application of Stokes drag law. For small departures from equilibrium ($Da << 1$), the self-propulsion is determined by the reaction velocity. In the large Da limit the surface reaction dominates over diffusion and the osmotic velocity cannot be greater than the speed of bath particles that are about to react. The implications of these features for different bath particle volume fractions and particle sizes are discussed. Theoretical predictions are compared with Brownian Dynamics simulations.

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