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Autonomous motion of semipermeable colloidal particles via chemical reactions: self-osmophoresis MISAEL DIAZ, UBALDO CORDOVA-FIGUEROA — While a large body of work exists on the design of catalytically-driven colloidal particles, little work exists on particles with the ability to permeate fluid through its surface that may be used for applications in lab-on-a-chip systems and drug delivery. We propose a model for the catalytically-driven motion of a semipermeable particle (e.g., non-motile microorganisms and vesicles) surrounded by reactant solutes in a Newtonian fluid. It is assumed that a first-order consumption reaction of surrounding reactants—which could be enzymatic or catalytic—occurs on half of the outer surface of the membrane. In equilibrium, the osmotic pressure inside the particle balances that of outside. The reaction creates an imbalance in osmotic pressure, causing outer fluid facing the catalytic side to permeate inside the particle as inner fluid permeates through the passive side. This fluid motion satisfies mass conservation inside the particle, causing particle motion towards regions of low reactant concentration by a mechanism known as osmophoresis. Preliminary results show that the particle velocity–defined as a Péclet number–is a function of the permeability of the membrane, a "characteristic" osmotic velocity, and the Damköhler number–which is a measure of relative impacts of the diffusion and chemical reaction. The permeating fluid retards particle motion by dragging the solute against the induced osmotic imbalance.

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