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Locomotion of a rod-shaped nanomotor propelled by heterogeneous catalytic reactions JEFFREY MORAN, Mechanical Engineering, Arizona State University, JONATHAN POSNER, Mechanical Engineering, Chemical Engineering, Arizona State University — Bimetallic nanorods can autonomously propel themselves through aqueous solutions by using hydrogen peroxide as a fuel. Several physical arguments have been proposed to describe the physics underlying the chemically-powered locomotion of these synthetic nanomotors, but there is no accepted or detailed theory on the propulsion mechanism. A computational simulation and scaling analysis of rod-shaped nanoparticles with asymmetric surface fluxes is presented. The model shows that locomotion is driven by electric body forces that arise due to finite space charge and internally generated electric fields surrounding the rod. The electric fields and charge density are generated by dipolar cation fluxes, such as those generated by heterogeneous electrochemical reactions. The scaling analysis and detailed simulations predict that the nanomotor velocity depends on the reaction flux, nanorod electrical surface potential, solvent viscosity, and rod geometry. Strong agreement is observed between the scaling analysis and simulations.

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