Conductive Active Colloids Propelled by Releasing Ions

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By converting chemical energy into autonomous motion through tunable surface chemistries, synthetic active colloids provide a versatile platform for various applications, including targeted cancer therapies, cargo transport, and environmental remediation. **[1]**
These particles achieve propulsion driven by chemical potential gradients that induce fluid-mediated body forces through engineered asymmetric surface activities. **[2]**
Although the self-phoretic framework—originally developed for externally imposed electrolyte gradients—is commonly adapted to model these systems, its validity remains an open question for active particles that generate their own ionic gradients through surface reactions. **[3]**
We investigate the motion of an active colloidal particle with a fixed surface electrostatic potential that releases ionic species in an electrolyte solution. Our approach is based on the theoretical and numerical solutions of the full Nernst-Planck-Poisson equations, and we compare our findings to the predictions of a self-diffusiophoretic model. Our results exhibit several features that cannot be explained within the classic self-diffusiophoretic framework.
Our findings demonstrate that particles with zero surface potential can still achieve propulsion through the release of ionic species. Overall our results have implications for the design or the next generation of active nano and micro robots for biomedical applications.

Keywords:
Nano robots - Active colloids - Self propulsion

References:

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