Boundary effects on the locomotion of active Janus particles

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Active Particles

Self-propelled or “active” micrometer scale particles are capable of supplying local mechanical work, necessary for macroscale cargo delivery and useful in other applications within bioimaging and sensing. Active particles typically consist of native colloidal spheres with a cap of a second material covering some portion of the native particle. This poster reports the directed motion of platinum coated polystyrene particles at infinite dilution in the presence of H_2O_2, which acts as a fuel to drive motion. Furthermore, it reports our results of active particles swimming speed near a boundary with the presence of depletion forces which act to quench their locomotion as a form of speed control.

Mechanisms for Propulsion Control

- Active particles undergo self-propulsion by a mechanism called diffusiophoresis, due to local gradient in the chemical species following the breakdown of hydrogen peroxide into oxygen and water on the platinum cap.
- Manipulations of propulsion speed includes adding depletion suspensions in variable concentrations and analyzing their effects on the swimming speed.

Controlling the Response of Active Particles

- In the absence of fuel, the Janus particle displayed self-propulsion with a velocity that increased with increased concentration of H_2O_2.
- Addition of 20 nm non-adsorbing nanoparticles as depletants moved the particle closer to the nearby boundary.
- Simulation of a corresponding model shows promise in capturing experimental observations.

Conclusions and Acknowledgements

- Janus particles were prepared that displayed self-propulsion with a velocity that increased with increased concentration of H_2O_2.
- Addition of 20 nm non-adsorbing nanoparticles as depletants moved the particle closer to the nearby boundary.
- Moving the particle closer to the boundary quenched self-propulsion of the Janus particle.
- Simulation of a corresponding model shows promise in capturing experimental observations.

Fabrications of Active Particles

1. Polystyrene Monolayer formation

- "5 µm polystyrene particles deposited onto silicon substrate using a spin-coater (a).
- Future experiments will utilize newly designed blade coater (b).

2. Platinum Deposition

- (2) 10nm and 20nm of platinum were deposited onto the polystyrene. Dep. Rate 0.25 A/S

- Angstrom deposition instrument.
- SEM images of Janus particles
  - Stationary substrate.
  - Dep. rate 0.25 A/S

3. Retrieval of Janus particles and experimental procedure

- The silicon chips are sonicated in ultrapure water then centrifuged for purification.
- Janus particles are pipetted into the gasket and H_2O_2 is added in variable concentrations.

01/15/05

Acknowledgement