Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Chemical sailing: Nonspherical catalytic motors SERGEY SHKLYAEV, University of Puerto Rico, JOHN BRADY, California Institute of Technology, UBALDO CORDOVA-FIGUEROA, University of Puerto Rico, GROUP ON COLLOIDAL DYNAMICS TEAM — Self-propulsion of a chemically active particle (e.g. an osmotic motor) is a promising area that has a number of far-reaching applications. The conventional strategy is to construct a Janus particle that is chemically active on a portion of its surface, whereby an asymmetric concentration gradient of reactant is generated leading to osmotic propulsion. However, a nonspherical motor with uniform intensity of chemical reaction on its surface can also lead to osmotic propulsion, which allows for the design of simpler, cheaper motors. Wei & Jan (JFM, 2010) considered a weakly nonspherical motor and found the velocity of self-propulsion to be linear in terms of nonsphericity. However, we show that their calculations are in error and that net propulsion occurs at second order with respect to the nonsphericity. Moreover, hydrodynamic interactions (HI), which were neglected by Wei & Jan, can be of crucial importance—even the direction of self- propulsion can change with HI. Large departures from sphericity are also investigated numerically in an effort to determine the optimum shape for maximum propulsion.

Sergey Shklyaev
University of Puerto Rico

Date submitted: 26 Jul 2011 Electronic form version 1.4