Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Long-time self-diffusivity of a catalytic partcle in a dilute suspension SERGEY SHKLYAEV, California Institute of Technology, JOHN F. BRADY, California Institute of Technology, UBALDO M. CORDOVA–FIGUEROA, University of Puerto Rico — Active microrheology, which studies local changes in a microstructure of a suspension near a forced particle and a feedback of this redistribution on the particle motion, is of keen interest. Implementation of this concept to the chemically active particles is a promising field of research. We consider a long-time self-diffusivity of a catalytic (probe) particle dragged by an external force through a dilute suspension comprising reactant and product particles. The former decay at the contact with the probe particle producing s product particles. Neglecting by the hydrodynamic interaction, we derive the boundary value problem which governs the microstructures of the both types of suspended particles. Distortion of the microstructure due to both the motion of the probe and the chemical reaction leads to change in the tensor of long-time self-diffusivity. The problem is considered analytically in a several limiting cases and numerically otherwise. In the absence of advection contributions ensuing from reactant and product partcles are completely different. The first one is negative and tends to zero for the fast reaction, whereas the second one is not of fixed sign and remains finite in the mentioned limiting case. Advection amplifies both the contributions, the increase is more pronounced for the longitudinal component of the diffusivity tensor.

Sergey Shklyaev
California Institute of Technology

Date submitted: 29 Jul 2010 Electronic form version 1.4