Shear viscosity of two-state enzyme solutions

[1] Department of Chemistry, Tokyo Metropolitan University,

[2] Raymond and Beverly Sackler School of Physics and Astronomy, Tel Aviv University

Yuto Hosaka[1], Shigeyuki Komura[1], David Andelman[2]

〔**Introduction**〕

We discuss the shear viscosity of a Newtonian solution of catalytic enzymes and substrate molecules [1]. The enzyme is modeled as a two-state dimer consisting of two spherical domains connected with an elastic spring (see Fig. 1). We take into account the enzymatic conformational dynamics, which is induced by the binding of an additional elastic spring that represents a bond between the substrate and enzyme [2, 3]. Employing the Boltzmann distribution weighted by the waiting times of enzymatic species in each catalytic cycle, we obtain the shear viscosity of dilute enzyme solutions as a function of substrate concentration and its physical properties. The substrate affinity distinguishes between fast and slow enzymes, and the corresponding viscosity expressions are obtained. Furthermore, we connect the obtained viscosity with the diffusion coefficient of a tracer particle in enzyme solutions.

〔**Results and Discussion**〕

By analytically solving the constitutive equation, we find that the enzyme solution viscosity, η_e, presents both decreasing and increasing behaviors as the substrate concentration is increased, depending on the physical properties of the binding substrate. For a substrate larger than the enzyme, we see that η_e behaves as if no substrate were present because it does not affect the size of the enzyme.
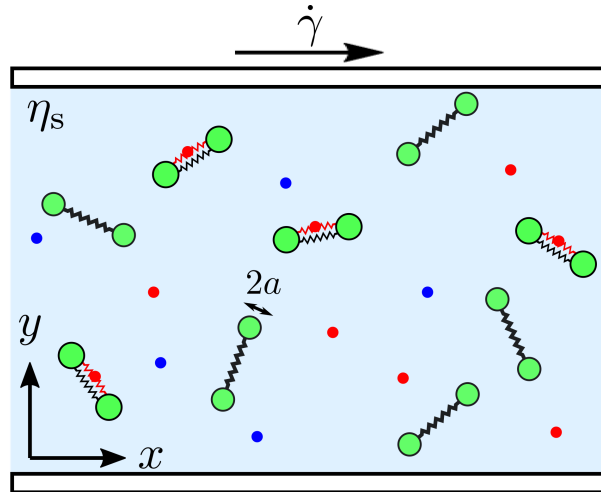

FIG.1   Schematic representation of a dilute solution of two-state dimers under steady shear flow with shear rate $\dot{\gamma}$

〔**References**〕

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