Diffusion and Microviscosity in Biomimetic Environment©

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Abstract:

Biological cells are known to be crowded with organelles and macromolecules such as proteins, DNA, RNA, actin filaments, and biomembranes. It is also believed that the cellular viscosity is heterogeneous. Macromolecular crowding and the heterogeneous viscosity in living cells are likely to influence the biomolecular diffusion, protein-protein and protein-substrate interaction, and protein folding. The objective of this project is to elucidate the difference between bulk viscosity and microviscosity and their effects on molecular diffusion in crowded environments. In these studies, we compare the microviscosity sensed by a diffusing molecule during rotational (nanosecond) and translation (millisecond) diffusion in a crowded environment using time-resolved anisotropy and fluorescence correlation spectroscopy, respectively. The results are compared with the bulk viscosity, which is measured using a viscometer, as well as a homogeneous environment created by glycerol at different concentrations in a buffer. Our results indicate that microviscosity differs from the corresponding bulk viscosity in a crowded environment, depending on the crowding agents (i.e., proteins versus polymers). In addition, we use the rotational and translational diffusion to elucidate the role of non-specific binding and the nature of the diffusion mechanism (i.e., Brownian versus non-Brownian diffusion) in a crowded environment.