Abstract

Single-Molecule Enzymology

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With the advent of room-temperature single-molecule spectroscopy, new information on dynamical processes of biomolecules is beginning to emerge. Enzymatic turnovers of single cholesterol oxidase molecules are observed in real time by monitoring the emission from the enzyme's fluorescent active site, flavin adenine dinucleotide (FAD). Although the chemical kinetic scheme based on the Michaelis-Menten provides a good description for the averaged behaviors of many molecules, it does not provide an accurate picture of the real-time behavior of a single molecule. Statistical analyses of single-molecule trajectories revealed a significant fluctuation in the rate of cholesterol oxidation by FAD. The rate fluctuation results from spontaneous and slow conformational motions of the enzyme. Static and dynamic disorders, i.e., the static heterogeneity and dynamic fluctuation of reaction rates, which are essentially indistinguishable in ensemble-averaged measurements, can now be determined separately by single-molecule measurements. New insights of enzymatic dynamics and function have emerged from single-molecule enzymology.

References:

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