Single Molecule Enzymology

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The advent of room-temperature single-molecule spectroscopy in the early 1990s has made it possible to follow enzymatic reactions and conformation dynamics of a single enzyme molecule in real time. We discovered that a single enzyme molecule exhibits temporal fluctuations of catalytic rates.[1] A general phenomenon hidden in conventional experiments, this arises from conformational fluctuations on a broad range of time scales, and has been directly proven by using electron transfer as a distance dependent probe.[2] These findings have raised an intriguing question: why does the Michaelis-Menten equation work so well despite the broad distributions and dynamic fluctuations at the single-molecule level? By developing a single-molecule assay of β-glactosidase with superb statistics, we proved that the Michaelis-Menten equation still holds for a fluctuating single enzyme molecule, but bears a different microscopic interpretation.[3]

References

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2. Yang et al 2003, Protein Conformational Dynamics Probed by Single-Molecule Electron Transfer, *Science* **302**, 262.
3. English et al. 2006, Ever-fluctuating Single Enzyme Molecules: Michaelis-Menten Equation Revisited, *Nat. Chem. Bio.* **2**, 87.