Biochemical kinetics and reaction mechanisms

**Biochemical reactions** carried out by enzymes are fundamental to the metabolic processes of catabolism, and anabolism. Similarly the binding events and signal modifications that are carried out by signaling and receptors proteins are important in the control functions of an organism. Studies of the mechanisms of these important biochemical agents allows insights into how an organisms functions at the molecular level.

The kinetics of biochemical reactions involves the study of rates of chemical processes involved in many processes. Measurements of the rates of reactions under different experimental conditions (for instance pH, solvent, concentration and temperature) allow the construction of models, using software tools like Pro-K II, that describe the characteristics of a biochemical reaction. This model provides insights into the reaction mechanisms involved in the reaction. The most important mechanistic reactions can be broadly classed as binding events, and enzymatic catalysis.

Binding events, such a protein-ligand binding and release, are fundamental to all biochemistry, from signaling pathways to binding of reactants in enzymatic reactions. The use of stopped-flow spectrophotometer are particularly powerful tools to study the kinetics of binding reactions, using fluorescence and other optical probes. This can provide information about the mechanisms of binding, and the energies involved.

Enzymatic reactions catalyze the conversion of metabolites and are the agents that carry out the large variety of specific chemical reactions in biology. As with all chemical kinetics, understanding of the number and rate of reactions, and building of reactions models around this information can provide profound insights into the mechanism of actions at the chemical level for enzymatic reactions.

Stopped-flow spectrophotometers like the SX20 allow the following of reaction kinetics, initiated by the mixing of two (or more) reactants, from the millisecond time range onwards, using changes in various optical probes, like fluorescence, fluorescence anisotropy, absorbance and circular dichroism. This allows a very diverse range of mechanism of many different types of biochemical reactions to be studied in great depth. For a more in depth explanation of the stopped-flow method please read the [tutorial](#).

Laser flash photolysis using the LKS.60 allows the reactions occurring in the nanosecond time range to be studied. Reactions are initiated by a very brief pulse of laser light. Then data is collected using a number of spectrometric techniques. This allows ultrafast reactions processes to be studied. For a more in depth explanation of the laser flash photolysis method please read the [tutorial](#).

**Relevant Binding Mechanisms References**

Listed below are 5 selected recent references of studies of various binding and macromolecular interaction mechanisms using APL stopped-flow and laser flash photolysis systems. A complete searchable database with all references can be accessed by [logging into](#) the APL members area.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Title</th>
<th>Year</th>
<th>Keywords</th>
<th>Journal/Proceedings</th>
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<tbody>
<tr>
<td>Celestine N Chi, Lisa Elftrom, Yao Shi, Ake Reassessing a sparse energetic network within a single protein domain</td>
<td>2008</td>
<td>allostery, coupling energy, dynamics, protein structure</td>
<td>PNAS 2008 vol.105 no. 12 pp 4670-4684</td>
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**Related Links**

- **Products**
  - Products at a glance
  - Chirascan CD spectrometer
  - Chirascan-plus CD spectrometer
  - SX20 stopped-flow spectrometer
  - LKS.60 laser flash photolysis
  - RX.2000 reaction analyzer

- **Applications**
  - Applications Overview
  - Automated Circular Dichroism Protein stability
  - Pharmacokinetics
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  - Biochemical Kinetics
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- **Techniques**
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  - Stopped-Flow
  - Laser flash
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- **References**
  - Product References
  - Spectroscopy Article
  - "Structure and Thermodynamics of a Monoclonal Antibody Biotherapeutic in Different Formulations"
Listed below are 5 selected recent references of studies a number of enzyme kinetic mechanisms using APL stopped-flow and laser flash photolysis systems. A complete searchable database with all references can be accessed by logging into the APL members area.

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<tr>
<td>Shiva Bhowmik, Geoff P. Horsman, Jeffrey T. Bolin, and Lindsay D. Ellis</td>
<td>The Molecular Basis for Inhibition of BphD, a CGC Bond Hydrolase Involved in Polychlorinated Biphenyls Degradation: LARGE 3-SUBSTITUENTS PREVENT TAUTOMERIZATION</td>
<td>2007</td>
<td>polychlorinated biphenyls, PCB, Bph, BphD, catalysis</td>
<td>J. Biol. Chem., 2007, Vol 282</td>
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<td>William C. Cooper, Yi Jin, and Trevor M. Penning</td>
<td>Elucidation of a Complete Kinetic Mechanism for a Mannichian Hydroxyxysteroid Dehydrogenase (HSD) and Identification of All Enzyme Forms on the Reaction Coordinate: THE EXAMPLE OF RAT LIVER 3a-HSD (AKR1C9)</td>
<td>2007</td>
<td>Hydroxyxysteroid dehydrogenase, steroid biosynthesis, enzyme kinetics</td>
<td>J. Biol. Chem., 2007, Vol 282, Iss 46, pp 33484-33493</td>
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