Faculty Profile

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Gordon Tollin

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Education and Appointments

- Ph.D. 1956, Iowa State University

Research Interests

- Biochemistry
- Bioanalytical
- Bioinorganic
- Biophysics
- Protein and Membrane Biochemistry
- Spectroscopy/molecular Structure

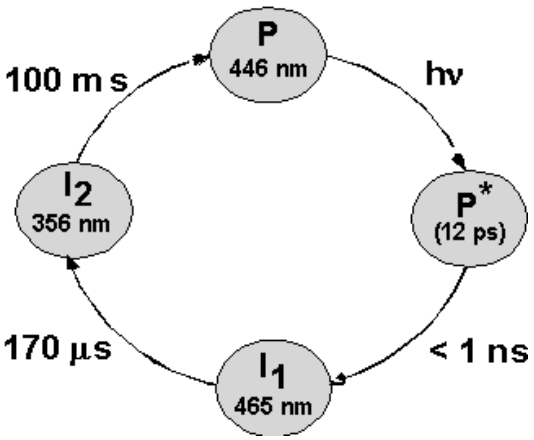
Research Summary

Mechanisms of signal transduction in membranes and biological electron transfer in proteins.

The transduction of information across biological membranes is one of the key processes in living systems. In many cases, such signals are transmitted via a class of integral membrane proteins known as G-protein coupled receptors (GPCRs). These are ubiquitous in eukaryotes and constitute one of the primary targets for pharmaceuticals. We have developed a new spectroscopic tool, called plasmon-waveguide resonance, that allows one to monitor conformational changes in real time in a single lipid bilayer occurring as a consequence of the functional activity of membrane proteins, without the use of labels of any kind. We are applying this to a variety of membrane systems, including GPCRs such as the delta opioid receptor, the beta-2-adrenergic receptor, the cannabinoid receptor and rhodopsin, and ion channels such as the nicotinic acetylcholine receptor.

Electron transfer processes play key roles in a wide variety of basic biological phenomena: e.g., respiration, photosynthesis, nitrogen fixation, steroid and DNA biogenesis, fatty acid and carbohydrate catabolism, etc. These reactions involve redox proteins consisting of one or more polypeptide chains, which bind cofactors such as metal ions (copper, iron-sulfur clusters) and metallo-organic (heme) or organic (flavin) molecules which function as electron or hydrogen carriers. Redox proteins may be soluble or membrane-associated, and electron transfer can occur via both inter- and intra-protein reactions. The primary goals of our research programs are to elucidate the relationships between redox protein structure and the biochemical specificity, the rates and the mechanisms of these reactions, and to understand the role of lipid bilayer membranes in controlling and modulating redox protein properties. The tools which we use

include transient-state kinetic methods such as stopped- flow and laser flash photolysis spectrophotometry, optical spectroscopic (including surface plasmon resonance) and electro-chemical methods, site-directed mutagenesis and computer molecular graphics.



Selected Publications

- Z. Salamon & G. Tollin "Graphical analysis of mass and anisotropy changes observed by plasmon-waveguide resonance spectroscopy can provide useful insights into membrane protein function," Biophys. J. 86, 2508 (2004).
- I.D. Alves, S.M. Cowell, Z. Salamon, S. Devanathan, G. Tollin & V.J. Hruby "Different structural states of the proteolipid membrane are produced by ligand binding to the human d-opioid receptor as shown by plasmon-waveguide resonance spectroscopy," Mol. Pharmacol. 65, 1248 (2004).
- S. Devanathan, Z. Yao, Z. Salamon, B. Kobilka & G. Tollin "Plasmon-waveguide resonance studies of ligand binding to the human ß2-adrenergic receptor," Biochemistry 43, 3280 (2004).
- I.D. Alves, K.A. Ciano, V. Boguslavski, E. Varga, Z. Salamon, H.I. Yamamura, V.J. Hruby & G. Tollin "Selectivity, cooperativity and reciprocity in the interactions between the d-opioid receptor, its ligands and G-proteins," J. Biol. Chem. 279, 44673 (2004).
- S. Devanathan, M.C. Walker, Z. Salamon & G. Tollin "Plasmon-waveguide resonance spectroscopy applied to three potential drug targets: cyclooxygenase-2, hepatitis C virus RNA polymerase and integrin aVb3," J. Pharmaceut. Biomed. Anal. 36, 711 (2004).
- S. Devanathan, Z. Salamon, G. Tollin, J. Fitch, T.E. Meyer & M.A. Cusanovich "Binding of oxidized and reduced cytochrome c2 to photosynthetic reaction centers: Plasmon-waveguide resonance spectroscopy," Biochemistry 43, 16405 (2004).
- I.D. Alves, G.F.J. Salgado, Z. Salamon, M.F. Brown, G. Tollin & V.J. Hruby, "Phosphatidylethanolamine enhances rhodopsin photoactivation and transducin binding in a solid supported lipid bilayer as determined using plasmon-waveguide resonance spectroscopy," Biophys. J. 88, 198 (2005).
- Z. Salamon, S. Devanathan, I.D. Alves & G. Tollin "Plasmon-waveguide resonance studies of lateral segregation into microdomains (rafts) in solid-supported bilayers," J. Biol. Chem. 280, 11175 (2005).
- I.D. Alves, Z. Salamon, V.J. Hruby & G. Tollin, "Ligand modulation of lateral segregation of a G-protein coupled receptor into lipid microdomains in sphingomyelin-phosphatidylcholine solid-supported bilayers," Biochemistry, 44, 9168 (2005).
- S. Devanathan, Z. Salamon, G. Lindblom, G. Grobner & G. Tollin, "Effects of sphingomyelin, cholesterol and zinc ions on the binding, insertion and aggregation of the amyloid Abeta (1-40) peptide in solid-supported lipid bilayers," FEBS Journal, 273, 1389 (2006).
- I.D. Alves, D. Delaroche, B. Mouillac, Z. Salamon, G. Tollin, V.J. Hruby, S. Lavielle & S. Sagan, "The two NK-1 binding sites correspond to distinct, independent, and non-interconvertible receptor conformational states as confirmed by plasmon-waveguide resonance spectroscopy," Biochemistry 45, 5309 (2006).
- C. Feng, G. Tollin, M.A. Holliday, C. Thomas, J.C. Salerno, J.H. Enemark & D.K. Ghosh, "Intraprotein electron transfer in a two-domain contstruct of neuronal nitric oxide synthase: the output state in nitric oxide formation," Biochemistry, 45, 6354-6362, 2006.
- U. Kappler, S. Bailey, C. Feng, M.J. Honeychruch, G.R. Hanson, P.V.Berhardt, G. Tollin and J.H. Enemark, "Kinetic and structural evidence for the importance of Tyr236 for the integrity of the Mo active site in a bacterial sulfite dehydrogenase," Biochemistry, 45, 9696-9705, 2006.
- V.J. Hruby, F. Porreca, H.I. Yamamura, G. Tolin, R.S. Agnes, Y.S. Lee, M. Cai, I. Alves, S. Cowell, E. Varga, P. Davis, Z. Salamon, W. Roeske, T. Vanderah and J. Lai, "New paradigms and tools in drug design for pain and addiction," AAPS, 8, E450-E460, 2006.
- C. Feng, G. Tollin, J.T. Hazzard, N.J. Nahm, J.G. Guillemette, J.C. Salerno and D.K. Ghosh, "Direct measurement by laser photolysis of intraprotein electron transfer in a rat neuronal nitric oxide synthase," J. Am. Chem., 129, 5621-5629, 2007.
- C. Feng, G. Tollin and J.H. Enemark, "Sulfite oxidizing enzymes," Biochim. Biophys. Acta., 1774, 527-539, 2007.
- S. Devanathan, Z. Salamon, G. Tollin, J.C. Fitch, T.E. Meyer, E.A. Berry and M.A.

Cusanovich, "Plasmon Waveguide Resonance Spectroscopic Evidence for Differential Binding of Oxidized and Reduced Rhodobacter Capsulatus Cytochrome c2 to the Cytochrome bc1 complex mediated by the Conformation of the Rieske Iron-Sulfur Protein," Biochemistry, 46, 7138-7145, 2007.

- V.J. Hruby and G. Tollin, "Plasmon-Waveguide Resonance (PWR) Spectroscopy for Directly Viewing Rates of GPCR/G-Protein Interactions and Quantifying Affinities," Curr. Opin. Pharmacol., 7, 507-514, 2007.
- Z. Salamon, S. Devanathan and G. Tollin, "Plasmon-waveguide resonance spectroscopy studies of lateral segregation in solid-supported proteolipid bilayers," in Methods in Molecular Biology, vol. 398, Lipid Rafts, edited by: T.J. McIntosh, Chap. 12, pp. 159-178, 2007
- T. Georgieva, S. Devanathan, D. Stropova, C.K. Park, Z. Salamon, G. Tollin, V.J. Hruby, W.R. Roeske, H.I. Yamamura and E. Varga, "Unique Agonist-Bound Cannabinoid CB(1) Receptor Conformation Indicate Agonist Specificity in Signaling," Eur. J. Pharmacol. 581, 19-29 (2008).

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