Modification of a ligand-receptor pair for electron-transfer

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Quantifying the energetics of weak interactions (van der Waal's forces, hydrogen bonding) in biological ligand-receptor pairs can be elusive. Insight into the biochemical role these forces play is critical to an understanding of signal transduction events and the drug discovery process. These weak interactions are essential in biological electron transfer (ET) events and are described in semiclassical Marcus theory of donor-acceptor pairs. We have modified a native protein substrate to include a donor complex to permit an investigation of ligand-receptor binding events in solution where the acceptor is a redox mediator or an electrode. Ruthenium pentaammine and iron tetracyano complexes modified with either biotin or desthiobiotin have been synthesized. Kinetics, thermodynamics and crystallographic structural studies of these modified biological ligands show they bind to the protein avidin in a manner similar to that of native biotin. Redox mediators have been used to show that the avidin-bound complexes are electrochemically accessible and electron transfer rates have been estimated. Theoretical methods applied to model the system indicate the complexes bind similarly to the unmodified ligands. Expected shifts in redox potential upon binding have also been calculated.