

## Photoacoustic calorimetry of purple membrane

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Photoacoustic measurements on suspensions of purple membrane fragments extracted from the halophilic bacterium *Halobacterium halobium* were used to determine the thermal energy changes associated with the photochemically induced intermediates and conformational states of bacteriorhodopsin. The photoacoustic technique monitors thermal oscillations in the sample which are induced by a modulated light input. These thermal changes are sensed as modulated pressure changes with a microphone in contact with the air layer above the sample. Several of the decay times associated with the enthalpy changes, as calculated from the frequency response of the photoacoustic signal, can be correlated with known lifetimes of the photocycle intermediates. The frequency response curve at 280 nm exhibits the same pattern of peaks as that seen with a visible excitation wavelength (565 nm), indicating photoactivity induced by absorption at that wavelength. Energy changes which are not directly correlated with the known photocycle can be associated with conformational changes in the protein retinal complex. These energy changes are a function of pH and ionic strength.

## Some aspects of the photochemistry of indole and tryptophan

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The photochemistry of indole and tryptophan (Trp) was studied with respect to two phenomena: (a) the influence of the excitation wavelength on the photoionization of the indole ring; (b) the effect of the environment on the photodegradation of Trp residues in proteins.

(1) We showed that in oxygen-free neutral aqueous solution the photoionization efficiencies of indole and Trp are constant within the first absorption band, which excludes a threshold process. In the second band the efficiency increases, indicating that this process competes with the internal conversion to the  $S_1$  state.