

### ABSTRACT

## “Surface enhanced vibrational spectroscopies and bioelectrochemistry: developing tools to understand the reaction mechanism of proteins”

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The molecular details of energy supply mechanisms, which are central to life, are in the focus of our research. Experiments have been developed, which reveal how protons, other ions and water molecules are drawn through membrane proteins, how the synthesis of small molecules is catalyzed and how these processes are coupled to electron transfer reactions or to conformational movements. We focus on the structural, dynamic and energetic requirements of individual amino acids and the cofactor sites that rule them.

Vibrational spectroscopy provides molecular fingerprints of a proteins catalytic reaction. By combining infrared spectroscopies and solid-state plasmonic nanostructures with reaction-induced approaches, the observation of a proteins action is possible at the level of single functional groups within large proteins. This provides information essential for understanding an enzymatic mechanism. Different examples, including proton translocation in transport proteins (1, 2) and in enzymes of the respiratory chain (3, 4), will be given together with a perspective on the applications for the far infrared (THz) spectral range (5).

Furthermore, I will briefly introduce our disease-related studies, including the development of new diagnostic tools based on IR spectroscopy, as well as the identification of new enzyme inhibitors based on electrochemical biosensors.

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