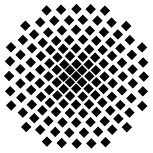
Stuttgarter Physikalisches Kolloquium

Max-Planck-Institut für Festkörperforschung
Max-Planck-Institut für Intelligente Systeme
Fachbereich Physik, Universität Stuttgart

Ansprechpartner: Christian Ast
E-Mail: C.Ast@fkf.mpg.de
Telefon: 0711 - 689-5250



Dienstag, 4. November 2014 | **17.15 Uhr** | **Hörsaal 2 D5**

Stuttgarter Max-Planck-Institute, Heisenbergstraße 1, 70569 Stuttgart-Büsnau

Novel IR spectroscopies to study biological membranes and membrane proteins

Joachim Heberle
Freie Universität Berlin

Abstract

Membrane proteins are the target of more than 50% of all drugs and are encoded by about 30% of the human genome. Electrophysiological techniques, like patch-clamp, unravelled many functional aspects of membrane proteins but suffer from structural sensitivity. We have developed Surface Enhanced Infrared Difference Absorption Spectroscopy (SEIDAS) to probe potential-induced structural changes of a protein on the level of a monolayer (see Ref. 1 for a recent review). A novel concept is introduced to incorporate membrane proteins into solid supported lipid bilayers in an orientated manner via the affinity of the His-tag to the Ni-NTA terminated gold surface. General applicability of the methodological approach is shown by tethering photosystem II to the gold surface. In conjunction with hydrogenase, the basis is set towards a biomimetic system for H_2-production. FTIR difference spectra of a monolayer of sensory rhodopsin II were recorded under voltage-clamp conditions. This approach opens an avenue towards mechanistic studies of voltage-gated ion channels with unprecedented structural and temporal sensitivity. Finally, scanning near-field IR micrososcopy will be introduced and applied to study the structure of biomembranes[2].

Vibrational spectroscopic studies on the novel light-gated channelrhodopsin-2 (ChR2) will be presented. ChR2 represents a versatile tool in the new field of optogenetics where physiological reactions are controlled by light. We have followed the structural changes of ChR2 by static and time-resolved FT-IR spectroscopy and identified internal proton transfer reactions involving aspartate and glutamate residues[3]. As the resolved protonation changes transiently alter the electrostatics and H-bonding networks within the protein, we infer that they represent the missing mechanistic link between retinal photo-isomerization and channel gating.

References:
1. Ataka, K., Stripp, S., and Heberle, J., Biochim. Biophys. Acta **1828**, 2283 (2013)
2. Amenabar, I., Poly, S., Nuansing, W., Hubrich, E.H., Govyadinov, A., Huth, F., Krutokhvostov, R., Zhang, L., Knez, M., Heberle, J., Bittner, A., Hillenbrand, R., Nature Commun. **4**, 2890 (2013)
3. Lórenz-Fonfría, V.A., Resler, T., Krause, N., Nack, M., Gossing, M., Fischer von Mollard, G., Bamann, C., Bamberg, E., Schlesinger, R., and Heberle, J., Proc. Natl. Acad. Sci USA **110**, E1273-E1281 (2013)