

The Grateful Infrared – Novel IR Techniques to Probe the Functional Changes of Membrane Proteins



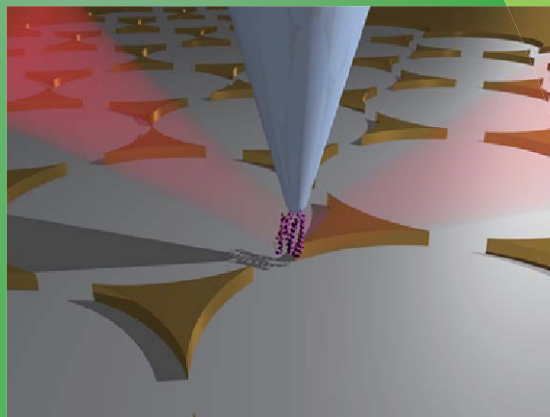
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Date & Time: 2018/1/23 (Tue.) 16:00-

Place: IMS Research Building Room 201

The catalytic activity of proteins is a function of structural changes. Very often these are as minute as protonation changes, hydrogen bonding changes and amino acid side chain reorientations. To resolve these, a methodology is afforded that not only provides the molecular sensitivity but allows to trace the sequence of these hierarchical reactions at the same time. I will showcase results from time-resolved IR spectroscopy using quantum cascade lasers [1,2] which was applied to channelrhodopsin [3], which represents the first light-activated ion channel to found the basis of the new and exciting field of optogenetics. A new ultrarapid-scanning FTIR spectrometer will also be introduced [4]. Finally, I shall provide an outlook towards novel experimental approaches like THz pump / IR probe spectroscopy or near-field IR nanoscopy (see figure below) that are currently developed in my lab [5]. We believe that some of these approaches have the potential to provide new science.



[1] Resler T, Schultz BJ, Lórenz-Fonfría VA, Schlesinger R, Heberle J., "Kinetic and Vibrational Isotope Effects of Proton Transfer Reactions in Channelrhodopsin-2". *Biophys J.* **109**, 287-297 (2015)

[2] Schultz, B.-J., Mohrmann, H., Lórenz-Fonfría, V.A., Heberle J. "Protein dynamics observed by tunable mid-IR quantum cascade lasers across the time range from 10 ns to 1 s." *Spectrochim. Acta A* (2017), <http://dx.doi.org/10.1016/j.saa.2017.01.010>

[3] Lorenz-Fonfría, V A, Heberle, J., "Channelrhodopsin unchained: Structure and mechanism of a light-gated cation channel". *Biochim Biophys Acta* **1837**, 626-642 (2014)

[4] Süß, B., Ringleb, F. and Heberle J., "New Ultrarapid-Scanning Interferometer for FT-IR spectroscopy with Microsecond Time-resolution." *Rev. Sci. Instr.* **87**, 063113 (2016)

[5] Kottke, T., Lórenz-Fonfría V.A., Heberle, J. "The Grateful Infrared – Sequential Protein Structural Changes Resolved by IR Difference Spectroscopy." *J. Phys. Chem. B* **121**, 335-350 (2017)