Nanoplasmonics and surface enhanced spectroscopy

Super-resolution infrared microscopy and spectroscopy

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Mid infrared (IR) absorption spectroscopy is a well established tool for identifying and analyzing inorganic as well as organic molecules. However, the used wavelengths limit the spatial resolution with conventional methods to several microns. To overcome this barrier we established a scattering type scanning near field infrared microscope (sSNIM), working with a previously published principle [1]. We employ the gold coated tip of an atomic force microscope (AFM) as a nano antenna, focusing the incident IR laser radiation – originating from a tunable quantum cascade laser (QCL) – to a well confined volume around the tips apex. Thereby the near field is enhanced by orders of magnitude [2]. Detecting the tip scattered light by a pseudoheterodyne detection scheme, enables IR absorption experiments with spatial resolution down to tens of *nm* and sensitivity down to single gold nano structures [3] and protein complexes embedded in individual membranes [4]. We see the potential application of this method in future single molecule IR difference absorption spectroscopy, which could yield insight into molecular mechanisms of individual proteins, such as bacteriorhodopsin (bR) – one of the best studied (membrane) proteins – or channelrhodopsin (ChR) – a protein currently widely applied in optogenetics. Another future perspective is the simultaneous use of IR absorption spectroscopy and force spectroscopy, which could reveal important details about folding pathways of individual proteins on the basis of mechanic and chemical time-resolved information.

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