Molecular orientation mapping down to sub-wavelength scale

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Polarisation of light can be used to measure orientation of absorbing dipoles, birefringent domains, material re-distribution in complex mixtures at very different spectral domains: from visible throughout infra-red (IR) to sub-mm wavelength at THz frequencies. Polarisation analysis at sub-wavelength scale is a challenging task and requires light-field enhancement using tailored sub-wavelength patterns and/or use of high intensity IR-THz beams at synchrotrons. We overview recent results in polarisation spectroscopy including use of metamaterials [1].

Polarisation analysis can be also transferred to attenuated total reflection (ATR) measurements at THz and IR spectral ranges [2]. Orientation of fibrils in bio-tissues can be determined using polarization analysis, which is relevant to number of medical conditions. The ATR mode of operation in materials with water can reveal absorbing structures at different depths of sample as water is undergoing phase transition. ATR technique is the most promising for THz spectral range due to strong water absorbance at room conditions. Due to long wavelength, large depth of sample (~wavelength/4) can be examined.

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