ANISOTROPY OF THIN FILMS AND AGGREGATES BY IR NANOPOLARIMETRY

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Resolving anisotropy at the nanoscale requires new spectroscopic methods overcoming the diffraction limit with high sensitivity to both the in- and out-of-plane optical properties of the sample. IR nanopolarimetry transfers the classical approach to the nanoscale by combining AFM-IR with polarized QCL sources (Fig. 1) [1]. The method uses an AFM tip to directly probe IR absorption via thermal expansion of the sample under p- and s-polarized low-power QCL pulses in ambient conditions allowing for straightforward spectra-structure correlations [2].

IR nanopolarimetry provides insights into anisotropy of thin films, surfaces, and aggregates including composition, interactions, molecular orientation, and oscillator strength induced phenomena with ≤ 30 nm spatial resolution in seconds [1–3].

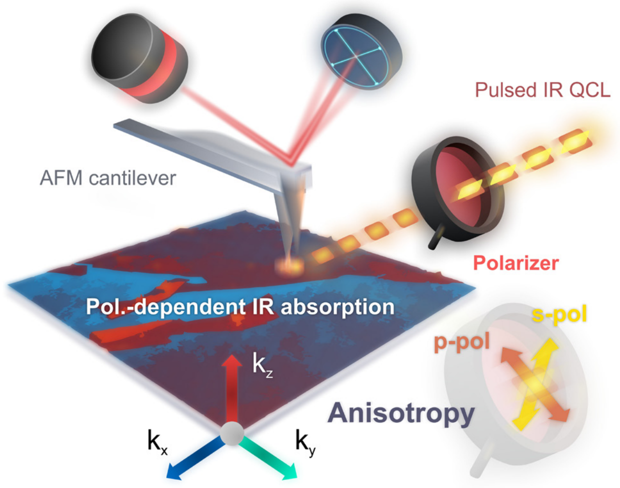

Fig. 1. Schematic of the AFM-IR nanopolarimetric setup in reflection geometry accessing in- and out-of-plane molecular anisotropy via polarization-dependent sample absorption

This presentation will highlight the broad applicability of the method to polymer science, (bio)macromolecular research, and IR nanophotonics by focusing on the following applications: anisotropy of layered thin polyimide films [1], ordering mechanisms of supramolecular porphyrin aggregates [2], oriented protein aggregation upon adsorption [1], polaritonic modes in thin silica films [3], and polarization-dependent biosensing of a peptide nucleic acid [4] on modified graphene films [5].

The analysis of the nanoscale anisotropy is supported by vibrational and electrodynamic calculations [1].

Keywords: Nanopolarimetry; AFM-IR; Anisotropy; Molecular orientation; Light–matter interactions; Spectra-structure correlations; Thin films; Aggregates; Polymers; Proteins; Oxides; Polaritons

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