Fritz-Haber-Institut der Max-Planck-Gesellschaft

Physikalische Chemie — Direktor: Prof. Dr. Martin Wolf

MAX-PLANCK-GESELLSCHAFT

Department Seminar:

Monday, February 12, 2018, at **11:00** a.m.;
— all are invited to meet at around 10:40 for a chat and coffee —

PD Dr. Karsten Hinrichs In Situ Spectroscopy,
Interface Analytics department,
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Infrared nanopolarimetric analysis of optically anisotropic thin films with strong and weak oscillators

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PC Seminar Room G2.06, Building G, Faradayweg 4 A. Paarmann

Abstract:

Infrared (IR) spectroscopic techniques can deliver simultaneously high chemical and structural contrast, can be coupled with optical models and numerical calculations and typically are non-destructive and label-free. Recent progress and perspectives in IR spectroscopic nanopolarimetric analysis (30 nm resolution) using an extended version of a photothermal IR nanoscopic technique (AFM-IR) for studying anisotropic optical properties are presented. [1-4] In particular results for organic and inorganic thin film materials are shown, which display significantly different optical properties in dependence of the strength of vibrational oscillators. Thin oxide films with strong oscillators can behave optically anisotropic due to absorption of polaritonic modes. The AFM-IR measuring the IR absorption provides direct information on the enhanced light–matter interactions in homogeneous oxide films. The so-called Berreman and ENZ (epsilon-near-zero) modes are observed only for very strong oscillators, e.g. in silicon oxide and silicon nitride films. However, even for polymer and biofilms with much less strong vibrational oscillators, certain vibrations, like νC=O (as e.g. in polyimide films) can exist for which oscillators are strong enough to produce considerable frequency shifts in the IR absorption. For organic materials as e.g. with very weak oscillators a direct interpretation of the nanopolarimetric spectra becomes feasible.

[1] T. Shaykhutdinov et al, Supramolecular Orientation in Anisotropic Assemblies by Infrared Nanopolarimetry, *ACS Macro Lett*. 2017. 6: 598-602.
[2] K. Hinrichs et al, Electrochemical Modification of Large Area Graphene and Characterization by Vibrational Spectroscopy, in K. Wandelt (ed.), *Encyclopedia of Interfacial Chemistry*, Elsevier (2018).
[3] T. Shaykhutdinov et al, Mid-infrared nanospectroscopy of Berreman mode and epsilon-near-zero local field confinement in thin films, *Opt. Mater. Express* 2017. 7: 3706-3714..
[4] F. Rösicke et al, Functionalization of any substrate using covalently modified large area CVD graphene, *Chem. Comm.* 2017. 53: 9308-9311.