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Seminar über Ultrafast Science and Technology

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Titel: Optical Pump-THz Ellipsometer Probe Measurements

Ellipsometry is well-established technique in a wide spectral range from far infrared to ultraviolet frequencies. It is still regarded as one of the best methods for determining the dielectric properties of materials and measuring the thickness of thin films. At terahertz (THz) frequencies, however, ellipsometry has not been widely applied despite its potential. Only recently, several publications have shown that THz time-domain spectroscopic ellipsometry (THz-TDSE) can be an accurate measure of material properties. THz-TDSE combines ellipsometry with THz time-domain spectroscopy and allows one to detect coherently sub-ps electromagnetic waves. This method is self-referenced, thus the signal to noise ratio can be very high. Furthermore, an in-depth study of time-resolved dielectric properties can be facilitated through the combination with an additional excitation pulse.
Here, we present the first time-resolved Optical-Pump/THz-Ellipsometer Probe (OPTEP) system together with proof of concept measurements carried out on a silicon. We solved the realignment problem for different angles of incidence (AOI) by delivering the EOS beam via a photonic bandgap fiber to the detection module. For different optical pump fluences, the variation of the complex refractive index arising from photo-carrier injection is well resolved. The experimental finding of optical properties shows good agreement with two temperature model simulations. The 2D time-frequency complex refractive index map results in a comprehensive understanding of the optical properties of different materials after photoexcitation. The sensitivity and time resolution of system can be further improved by improving the quality of phase reconstruction and by a better phase matching between excitation pump and THz waves at the sample position. As a suitable tool to study low density photo-carrier dynamics, our proposed system can contribute to perform time-resolved dielectric property measurements in the THz regime.

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