TECHNOLOGY
OFFER

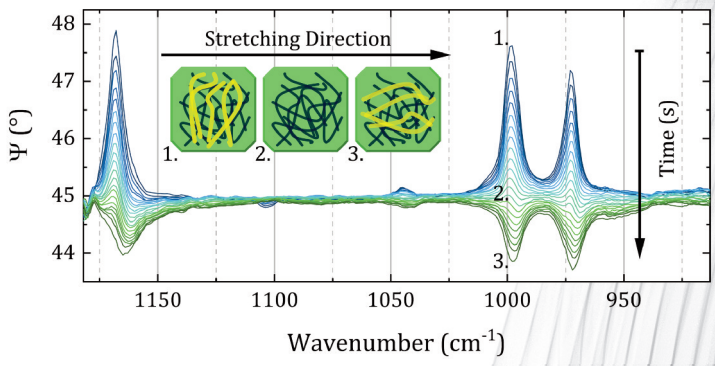
RECENDT
RESEARCH CENTER NON DESTRUCTIVE TESTING

Real-time mid-infrared spectroscopic ellipsometry for measurement of smallest material changes

Fast, sensitive and powerful! – for layers, defects, chemical changes, ...

Well-known as a powerful method for the non-destructive investigation of a wide variety of material properties, the optical technique of spectroscopic ellipsometry in the infrared spectral range has recently experienced a major leap in technical maturity and industrial applicability. By applying a quantum cascade laser, detailed information on layer thicknesses, complex refractive indices, anisotropy, defects and inhomogeneities can now be acquired in the split of a second at superior spatial resolution.

Spectroscopic ellipsometry analyzes the change of the polarization of electromagnetic radiation caused by light matter interaction at the surface, in layered structures, and inside the bulk material. By means of data modelling the gathered information can be transferred to a wide range of material properties and parameters. Thus, e.g. layer thicknesses, optical properties like the complex refractive index, anisotropy, defects, inhomogeneities and – especially in the infrared spectral range – chemical information and phonon properties are accessible. Whereas commercially available infrared ellipsometers rely on thermal sources, RECENDT implemented the world's first quantum cascade laser based spectroscopic ellipsometry system. Employing such broadband lasers, signal-to-noise ratios and measurement times could be improved by orders of magnitudes – measurements lasting 16 hours are now feasible in less than 1 second. Their unique emission properties additionally allow to probe highly absorbing samples, to measure in stand-off configurations, or to realize sensing solutions with essentially diffraction limited spatial resolution. Thus, infrared ellipsometry is now ready for industrial application.



Time resolved measurement of the dynamic molecular reorientation in a 6 µm polypropylene film during stretching. Each spectrum was recorded in 900 ms. As indicated in the inset, the amplitude of the observed bands directly relates to the predominant orientation of molecular chains. Adapted with permission from [1]. © The Optical Society

Facts/Key-Values/ Features & Benefits

- Contact free and non-destructive measurements
- Wide variety of material properties accessible
- Superior temporal resolution
- Essentially diffraction limited spatial resolution
- Monitoring of dynamic processes

Potential Users & Fields of Application

- Material characterization and quantification
- Process monitoring
- Identification of material inhomogeneities

Status – what do we offer?

- Customer specific measurement solutions
- Industrial implementations

Contact data

Robert Holzer
robert.holzer@recendt.at
+43 732 2468 4602

References, Publications

[1] Alexander Ebner, Robert Zimmerleiter, Christoph Cobet, Kurt Hingerl, Markus Brandstetter, and Jakob Kilgus, "Sub-second quantum cascade laser based infrared spectroscopic ellipsometry," Opt. Lett. 44, 3426-3429 (2019)

[2] Alexander Ebner, Robert Zimmerleiter, Kurt Hingerl, and Markus Brandstetter, "Towards Real-Time In-Situ Mid-Infrared Spectroscopic Ellipsometry in Polymer Processing," Polymers 14, no. 1: 7. (2022)

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