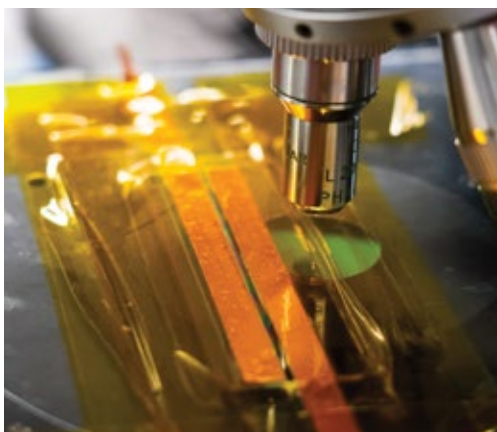
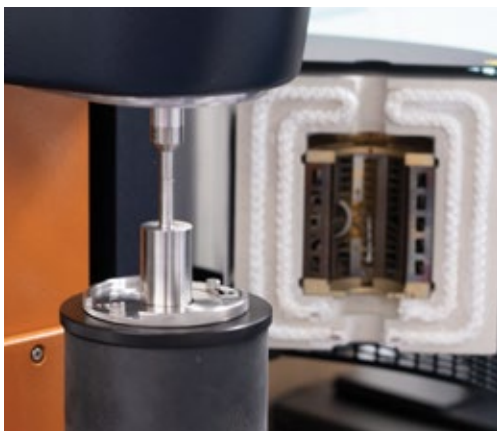
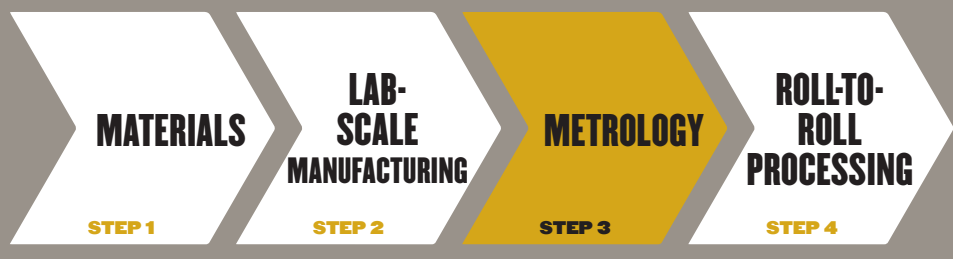


OFF-LINE METROLOGY METHODS OF ROLL-TO-ROLL PROCESSES



BIRCK NANOTECHNOLOGY CENTER ROLL-TO-ROLL PROCESS



OVERVIEW

Off-line metrology methods in the Birck Nanotechnology Center Roll-to-Roll laboratories are used to quantify properties of materials that are inputs to or outputs of roll-to-roll processes. A wide range of mechanical, optical, and thermal property measurements are possible, including rheometry, uniaxial and biaxial tension, optical birefringence, differential scanning calorimetry, thermogravimetric analysis, custom multi-parameter monitoring of solvent cast film drying, and combinations of these. These techniques are used to characterize basic materials like solvents and polymers, as well as processed materials like cast films or inks.

TA INSTRUMENTS DISCOVERY HYBRID RHEOMETER (DHR-3)

- Viscometry with Concentric Cylinder (Cup & Bob)
- Cone or parallel plate with lower Peltier plate
- DMA testing of films/fibers and 3-Point Bending Clamp
- Relative humidity control with film/fiber tension and parallel plate geometries
- Environmental Test Chamber, temperature range from -160°C to 600°C.
- Dielectric Accessory with 25 mm upper and lower dielectric geometry
- UV light guide for rheological characterization of UV curable materials under ambient conditions.

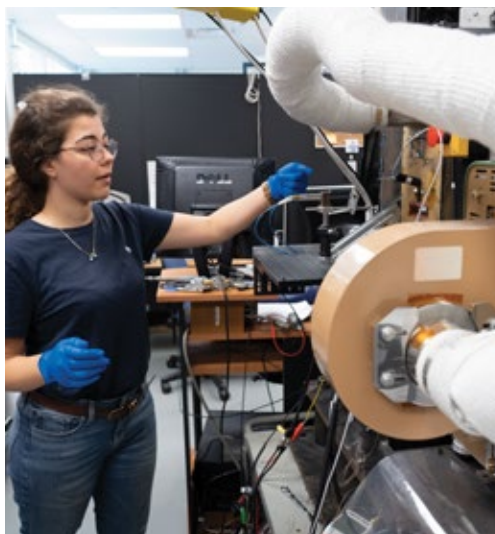
NETZCH DIFFERENTIAL SCANNING CALORIMETER AND THERMOGRAVIMETRIC ANALYZER

DSC 214 Polyma

- Temp. range -170 to 600°C
- Heating/Cooling rate 0.001 to 500 K/min

TG 209 F3 Tarsus

- Temperature range RT to 1000°C
 - Heating rate 0.001 to 200 K/min
- Only a few mg sample needed for both.

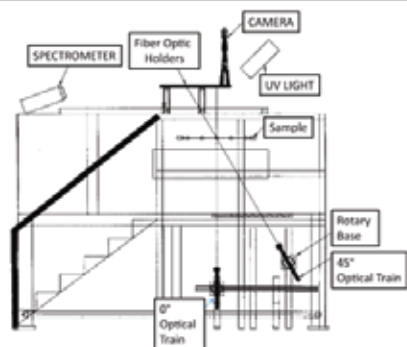


A2 UNIAXIAL TENSION MECHANICAL-OPTICAL TESTER

A2 is a custom-made device to probe uniaxial tensile mechano-optical behavior on film samples.

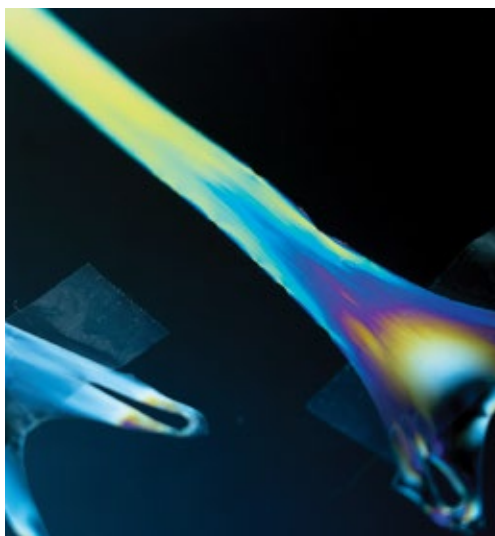
- Uniaxial stretching with crosshead speeds from 1-1000 mm/min
- Stretch & hold protocols (for relaxation experiments)
- Cyclic loading – unloading experiments
- Measuring resistance by applying pressure
- Uniaxial tensile test at room temperature and high temperatures
- Optical birefringence measured in real time during mechanical testing.

BIAXIAL TENSION MECHANICAL-OPTICAL TESTER



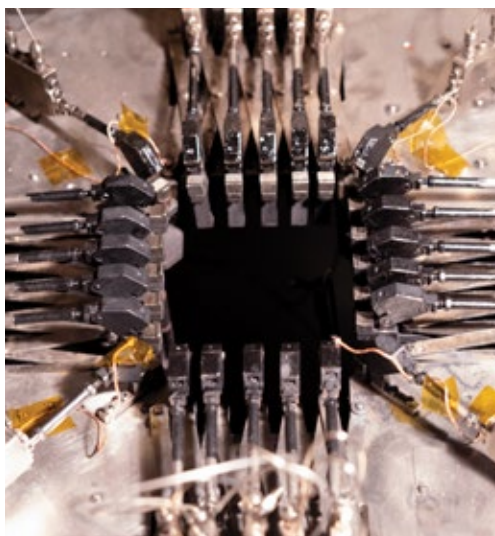
Stretching Protocols

1. Simultaneous Biaxial Stretching (Laminated Film)
2. Sequential Biaxial Stretching (Packaging Film)
3. Longitudinal Multi-Stage Stretching (Heat Shrinkage Film)
4. Combined Simultaneous and Sequential Biaxial Stretching (Flexible Disk)
5. Stretching While Heat Setting (Controlling wrinkles during annealing)



REAL-TIME DRYING AND OPTICAL BEHAVIOR OF SOLVENT CAST FILMS (JOEY)

- Laminar, controlled temperature (RT to 150°C) airflow is supplied to dry a solvent cast film.
- Measures cast film weight, thickness, in-plane and out-of-plane birefringence, and surface temperature in real time during evaporation of solvent from polymer solutions and coatings.
- Determine steady state drying time for roll-to-roll process planning.



CONTACT INFORMATION

OFF-LINE METROLOGY METHODS OF ROLL-TO-ROLL PROCESSES

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