

- 1 Roughness sensor horos.
- 2 Measuring objects.
- 3 Scatter distribution of diamond turned Al-surface.
- 4 Roughness measurements using horos and WLI (1 - Mo/Si-mirror, 2 - Ti-coating 3 - diamond turned Al-surface).

## horos

# COMPACT OPTICAL ROUGHNESS SENSOR

### Fraunhofer Institute for Applied Optics and Precision Engineering IOF

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#### Motivation

Stringent demand for surface characterization techniques that are non-contact, fast, compact, and applicable to a wide range of surface qualities – from machined components to optical surfaces.

#### The Sensor

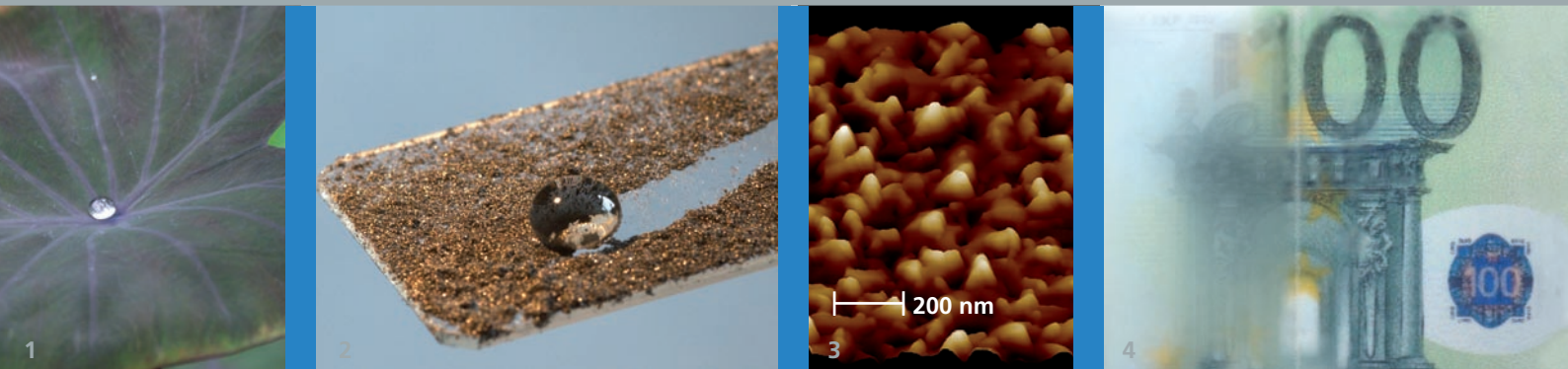
*horos* (high sensitive optical roughness sensor) is a mobile, light scattering based tool to measure surface roughness from the micrometer to subnanometer scales.

#### Features

- Roughness parameters, PSD, 3D-scattering distribution, isotropy etc.
- Sensitivity:  $R_q < 0,5 \text{ nm}$
- Measurement time:  $< 1 \text{ s}$
- Direct link to profilometric techniques

#### Applications

- Quality control for
- Plane and complex (freeform) surfaces
  - Optical fabrication (surface-finishing, coating, molding etc.)
  - Mechanical engineering
  - Automotive industry



- 1 *Ultra-hydrophobic leaf of Taro plant.*
- 2 *Self cleaning effect on glass surface with ultra-hydrophobic coating.*
- 3 *Nanostructure of the sol-gel coating.*
- 4 *Fogging-test: bank note viewed through glass with (half-site) hydrophilic coating (left: uncoated, right: coated).*

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## ULTRA-HYDROPHOBIC AND HYDROPHILIC / ANTI-FOG GLASS SURFACES

### Motivation

Roughness structures in the micro- and nano-ranges play a key role for functional surfaces. Ultra-hydrophobic, hydrophilic, and anti-fog properties can be achieved by a variety of stochastic, but deliberately tailored roughness characteristics. This results in promising potentials for the fabrication of such structures. Moreover, it even allows for linking the functional properties with optical quality (e.g. for glass surfaces). At the same time, novel challenges arise for appropriate characterization methods as well as simulation and modelling techniques.

### Solution

With the flexible modelling-, measurement- and analysis tools developed at Fraunhofer IOF we are capable of predicting, defining and controlling roughness structures for optimal hydrophobic and hydrophilic properties. The direct link of simulation, fabrication, and characterization constitutes a unique basis for efficiently triggering the entire process chain.

### Implementation

Sol-gel coatings from ETC PRODUCTS GmbH with adjustable nano roughness enable the fabrication of both ultra-hydrophobic (advancing contact angle:  $155^\circ$ , hysteresis  $< 30^\circ$ ) and hydrophilic, anti-fog glass surfaces. At the same time, scattering losses are minimized.