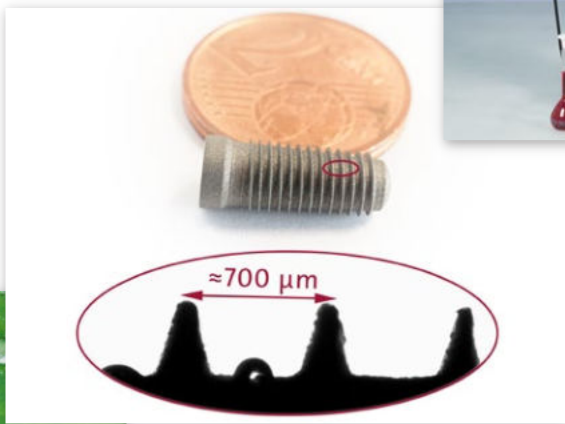
OCA product series

Optical contact angle measuring and contour analysis systems ranging from basic device to fully automated measuring systems for micro-structured samples



Optical contact angle measurement and drop contour analysis

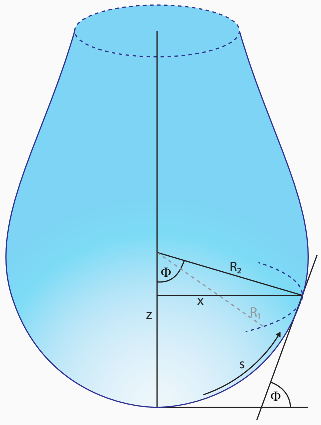
The optical analysis of drops that hang from a dosing needle or are placed on a solid surface facilitates the determination of different surface and interfacial parameters. The **contact angle** that a liquid drop establishes on a solid surface characterises the solid's wetting behaviour with said liquid.

Having measured the contact angles of multiple test liquids the **surface energy of the solid** can be determined and the latter can be used to calculate the work of adhesion for different liquids.

The reliable and experimentally robust measurement of the contact angle aids on the development of surface coatings, composite materials, paints and varnishes or cleaning agents. In short: the measurement of contact angle helps in all situations where solids and liquids meet and advantage is to be gained by the control of wetting and adhesion properties.

Young-Laplace evaluation

When no other factor is in play a drop of liquid tends to form a sphere, due to its surface tension. The typical drop shape materialises because the drop is elongated due to gravity. The Young-Laplace evaluation of pendant drops recognises this fact: The characteristic shape of the drop profile yields the surface tension σ_L of a liquid.



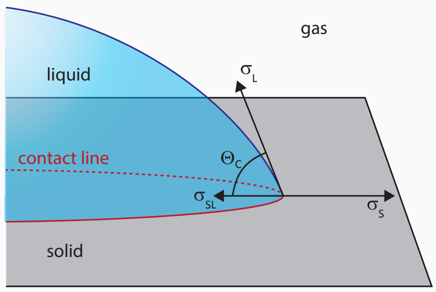
In the case where a pendant drop is surrounded by a second liquid, rather than air, the interfacial tension between the two liquids can be deduced from the drop shape. For optical analysis the outer liquid has to be transparent. Depending on the relative densities, the inner liquid can be dosed either as a pendant drop or upwards, via a bent needle.

Young equation

An equilibrium of vectorial forces dictates the **contact angle** Θ_c at the three phase contact line of a deposited drop. The surface energy of the solid σ_s acts along the solid surface. The solid-liquid interfacial energy σ_{SL} acts in the opposite direction and the surface tension σ_L of the liquid acts tangential to the drop surface. This can be described by a simple scalar equation:

$$\sigma_L \cos \Theta_C = \sigma_S - \sigma_{SL}$$ **Young equation**

The drop is viewed in profile during the contact angle measurement. The image processing software recognises and records the drop contour, as well as the base line at the solid-liquid interface, and fits a mathematical function to the drop shape.



Surface energy of solids

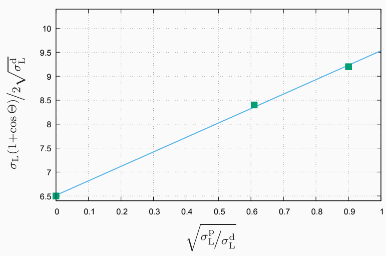
To determine the surface energy of a solid one measures the contact angles of test liquids whose surface tensions including their dispersive and polar parts are known. These dispersive and polar parts are used to calculate the interfacial tension σ_{SL} between the solid and a liquid based on a suitable model.

An often applied model is the one of Owens, Wendt, Rabel and Kaelble (**OWRK model**) which considers the geometric mean of the dispersive and polar parts of the liquid's surface tension σ_L and of the solid's surface energy σ_S:

$$\sigma_{SL} = \sigma_S + \sigma_L - 2\sqrt{\sigma_S^d \sigma_L^d} - 2\sqrt{\sigma_S^P \sigma_L^P}$$

Substituting this expression in the Young equation, the polar and the dispersive part of the solid's surface energy can be determined from the regression line in a suitable plot.

The linear regression requires contact angle measurements with at least two different test liquids. However, as a regression line based on just two points contains no information on the accuracy of the result, contact angle measurements with at least three test liquids are recommended for the determination of the surface energy of solids.

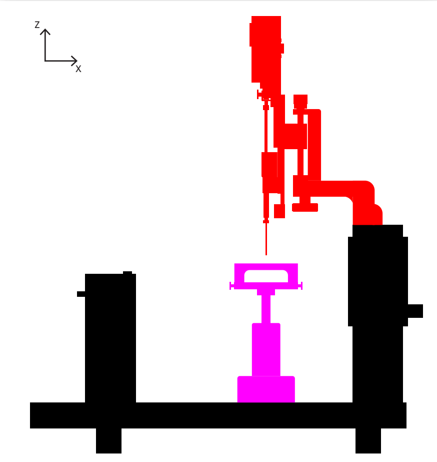


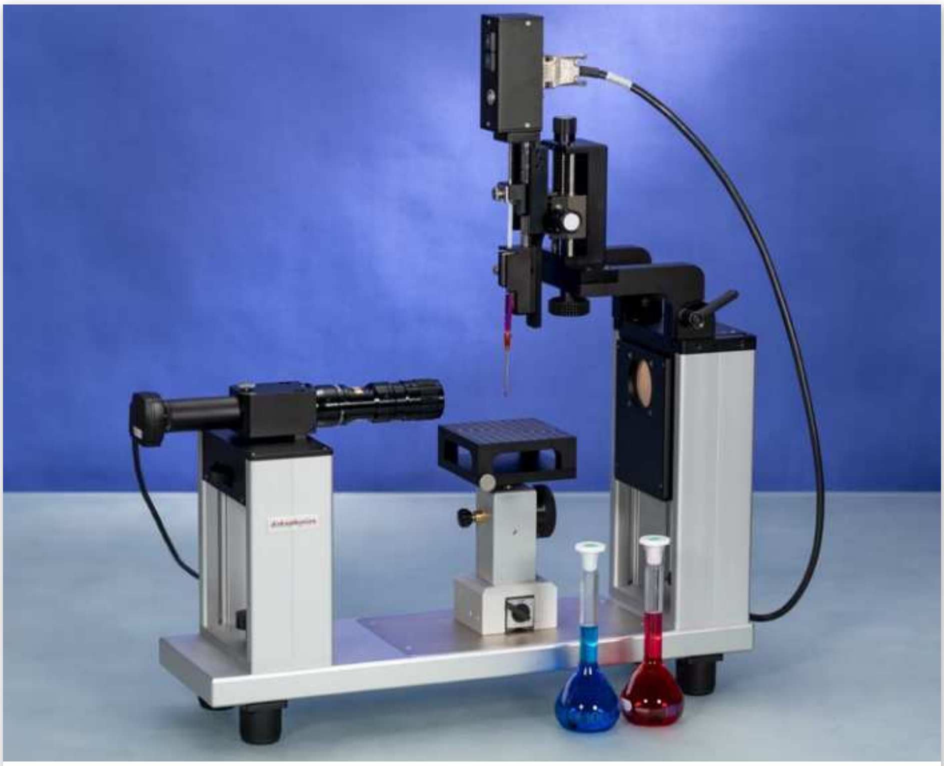
Lotus effect

A well quoted example of **large contact angles** can be found in nature: when water droplets come into contact with a lotus leaf they roll off without wetting the surface. During 'roll off' the drops take dirt particles with them, resulting in the self-cleaning of the leaf. Mimicking this "Lotus effect" is a popular research and product development topic in many technical fields. Self-cleaning facades, ceramics and other surfaces are regarded as highly desirable. In this context the ability to measure and record contact angles, of course, plays an essential role.

The OCA models

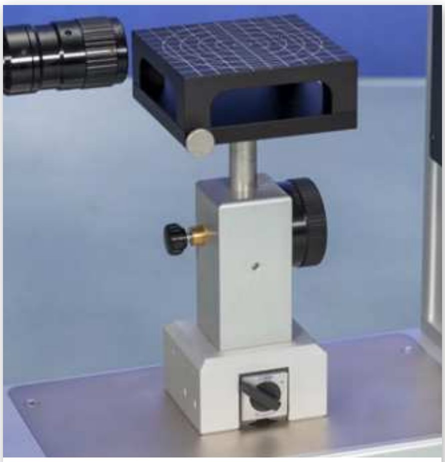
The optical contact angle measuring and contour analysis systems of the OCA series combine ,
exact liquid dosing and **precise sample positioning** into powerful and reliable measuring systems.





The modular approach to all hardware components allows for a multitude of configurations, ranging from **manually operated basic devices** to **fully automated high-performance measuring systems**.

All OCA models are based on a common design philosophy and are built with a **sturdy aluminium metal frame**. Moreover, they all feature a **LED lighting** with manually and software-controlled intensity. Due to an automatic temperature drift compensation a stable and homogeneous illumination of the sample is guaranteed at all times.



OCA 15EC

The OCA 15EC is the **entry level measuring device** for professional contact angle measurements and drop shape analysis.

The sample table of the OCA 15EC can slide freely in **X- and Y-direction** and is locked into position with its **switchable magnetic base**. In **Z-direction** the sample table is adjustable using **precision mechanics with a hand wheel**.

The fast with manual focus and adjustable observation angle in combination with the ensures pin-sharp drop images and facilitates the effortless analysis with the SCA software.

With a **single direct dosing system SD-DM** or a **double direct dosing system DD-DM** liquids can be positioned and dosed with one or two **electronic syringe modules ESr-N**, respectively.

Direct tubeless dosing of the syringe content and the ability to use cost-saving disposable syringes and needles allow for short preparation times and minimal cleaning efforts.

Even though the OCA 15EC is a high precision measuring device designed for laboratory use, it is highly mobile and can effortlessly be taken apart with two star grip screws and be stored securely in a **transport case**.

OCA 15LJ

The OCA 15LJ is a special variant of the OCA 15EC that is designed to support the DataPhysics **Liquid Jet systems** like the **Double Liquid Jet system DLJ**.

With the multiple drops fit into the frame and can be analysed simultaneously due to the higher resolution and .

The **additional connecting sockets** for accessories/extensions on the side of the illumination housing enable a mounting of up to four syringe modules.

Hence, multiple drops can be simultaneously dosed and analysed for a surface energy determination in **one-click**.

Software for an efficient workflow

The SCA software, designed for Microsoft Windows®, is the modular program for all OCA instruments.

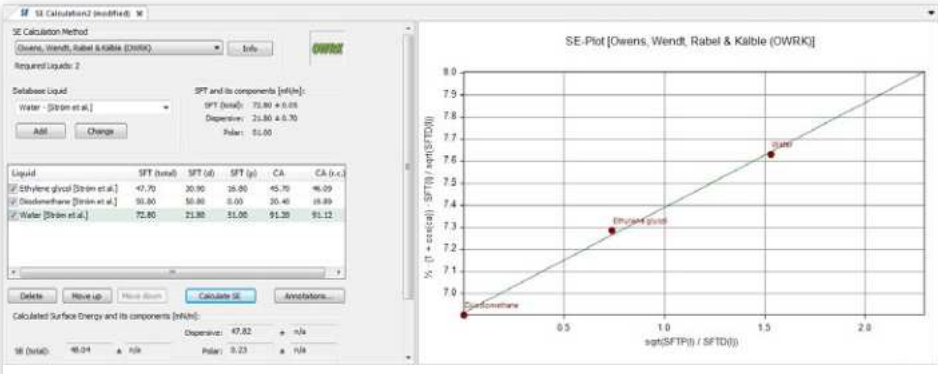
The **modern user interface** is highly customisable and offers every user an individual and ideally suited overview during measurements.

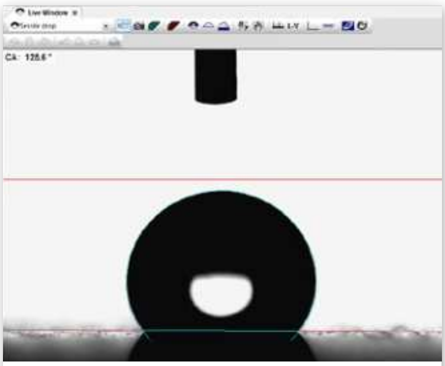
A software-integrated **extensive database** comprises important physical and chemical parameters of a multitude of liquids and solids.

The SCA software features **recording and storing of movie sequences** which allows for a controlled evaluation of even the fastest processes.

Due to a newly developed **automation dialogue** the automated control of all electronic components becomes effortless. For example, an entire sample can be mapped automatically determining the surface energy with up to four liquids. The position of every drop can either be set according to predefined patterns or individually using the **intuitive visual drop positioning function**.

The SCA software is divided into the following separately available modules:



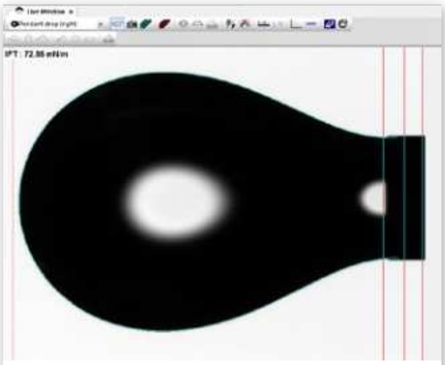


SCA 20 — contact angle

- measurement and presentation of the static contact angle on plane, convex and concave surfaces according to the sessile drop and the captive drop method
- automatic baseline detection on flat and curved surfaces
- surface roughness correction with optional Surface Profile Analyzer SPA 25
- measurement of dynamic contact angles (advancing and receding angle, contact angle hysteresis) according to the needle-in-drop method and the tilting method

SCA 21 — surface energy

- determination of the surface energy of solids as well as of its components (e.g. dispersive, polar and hydrogen bond parts, acid and base portions) according to nine different theories
- calculation and representation of wetting envelopes and work of adhesion/ contact angle diagrams



SCA 22 — surface/interfacial tension

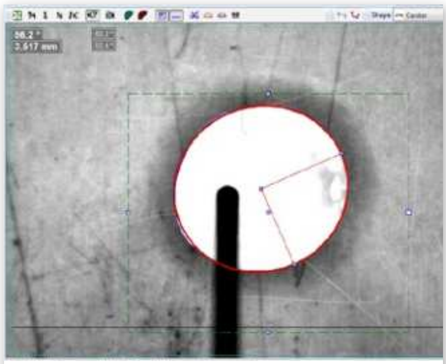
- determination of the surface and interfacial tension, as well as of their polar and dispersive parts, based on the Young-Laplace evaluation of pendant drops

SCA 23 — liquid bridge analysis

- determination of the surface and interfacial tension based on the evaluation of the lamella contour
- liquid bridge analysis of 3-phase systems

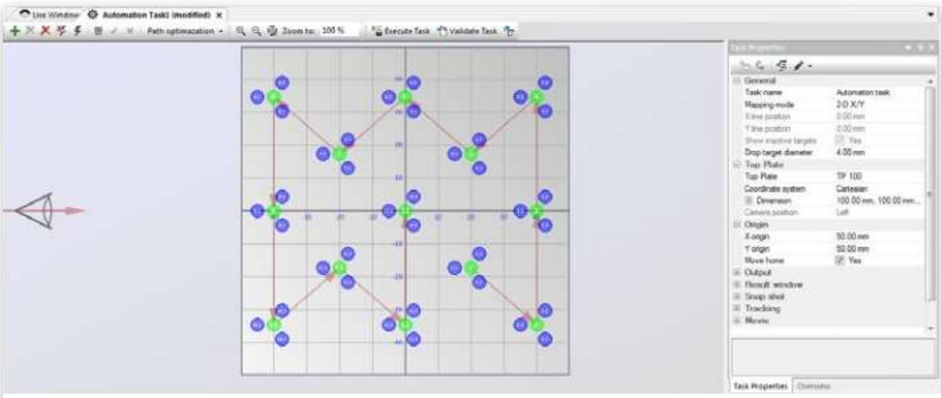
SCA 26 — oscillation / relaxation

- determination of the real and the imaginary part of the interfacial dilatational modulus based on the contour of oscillating and relaxing pendant drops



SCA 27 — contact angle in topview

- determination of the contact angle based on the drop radius analysed in topview measurements and the drop volume



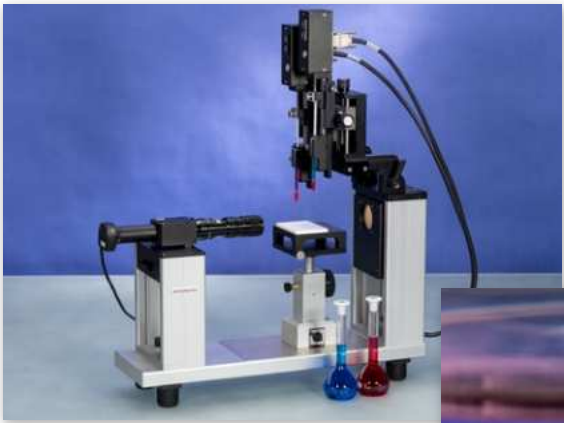
Available measuring methods and technical data

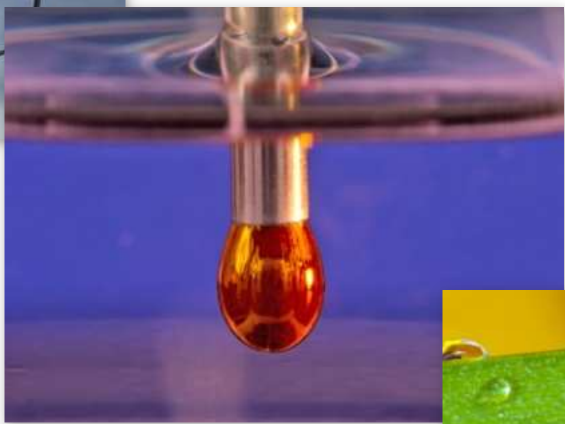
	[illegible]	[illegible]	[illegible]	[illegible]
[illegible] [SCA 20]	○	○	○	○
measuring range	0 ... 180°	0 ... 180°	0 ... 180°	0 ... 180°
accuracy	± 0.1°	± 0.1°	± 0.1°	± 0.1°
resolution	± 0.01°	± 0.01°	± 0.01°	± 0.01°
[illegible] [SCA 22]	○	○	○	○
measuring range	0.01 ... 2000 mN/m	0.01 ... 2000 mN/m	0.01 ... 2000 mN/m	0.01 ... 2000 mN/m
resolution	± 0.01 mN/m	± 0.01 mN/m	± 0.01 mN/m	± 0.01 mN/m
[illegible] [SCA 21]	○	○	○	○
[illegible] [SCA 23]	○	○	○	○
[illegible] [SCA 26]	○	○	○	○
[illegible] [SCA 27]	—	○	○	○
[illegible]	sliding magnetic base	manual precision axes	electronic precision axes	electronic precision axes
traversing range (X-axis [mm] x Y-axis [mm] x Z-axis [mm])	110 x 90 x 42	100 x 104 x 42	100 x 105 x 50	100 x 105 x 50
traversing speed (X- and Y-axis)	—	—	75 nm/s ... 20 mm/s	75 nm/s ... 20 mm/s
traversing speed (Z-axis)	—	—	75 nm/s ... 25 mm/s	75 nm/s ... 25 mm/s
positioning resolution	—	—	± 39 nm	± 39 nm
max. sample weight	3.0 kg (locked Z-axis: 15.0 kg)	3.0 kg (locked Z-axis: 15.0 kg)	10.0 kg	10.0 kg
[illegible] with manual and software-controlled intensity including automatic temperature drift compensation				
warm-white LED (3000 K)	●	●	●	●
monochromatic red LED (660 nm)	○	○	○	○
monochromatic blue LED (465 nm)	○	○	○	○
[illegible]				
temperature chambers (-30 °C to 700 °C)	○	○	○	○
electrical needle heating device (RT ... 700 °C)	○	○	○	○
humidity generator of the HGC series	○	○	○	○

● integrated ○ with optional software/accessory — not available

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]						
6.5-fold zoom lens with integrated manual focus (± 6 mm)	●		●	●		—
10-fold zoom lens with software-controlled focus (± 4,5 mm) and observation angle (-9° ... +2°2‘)	—		—	—		●
fi[illegible] (X min x Y min) ... (X max x Y max)						
(1.11 mm x 0.83 mm) ... (7.14 mm x 5.35 mm)	●	—	—	—	●	—
(2.50 mm x 1.33 mm) ... (16.09 mm x 8.55 mm)	○	●	●	●	○	—
(1.12 mm x 0.58 mm) ... (11.29 mm x 5.98 mm)	—	—	—	—	—	●
[illegible]						
USB 3 camera, 1/3" sensor max. resolution 1448 x 1086 pixel with 156 frames/s, max. frame rate 3246 frames/s with 1448 x 60 pixel	●	—	—	—	●	—
USB 3 camera, 2/3" sensor max. resolution 2048 x 1088 pixel with 180 frames/s, max. frame rate 3250 frames/s with 2048 x 60 pixel	○	●	●	●	○	●
high-speed camera system	on request		on request	on request		on request
[illegible] for accessories/extensions	3	7	9	15	9	15
[illegible]	○		○	●	○	●
[illegible] (L [mm] x W [mm] x H [mm])	550 x 160 x 365		660 x 220 x 365	680 x 310 x 370		680 x 310 x 370
[illegible]	14 kg	15 kg	16 kg	26 kg		28 kg
[illegible]	100 ... 240 VAC; 50 ... 60 Hz; 70 W		100 ... 240 VAC; 50 ... 60 Hz; 70 W	100 ... 240 VAC; 50 ... 60 Hz; 70 W		100 ... 240 VAC; 50 ... 60 Hz; 70 W

● integrated ○ with optional software/accessory — not available





**For more information please contact us.
We will find a tailor-made solution to your
surface chemistry requirements and
will be pleased to provide a quotation,
obligation-free, for your instrument system.**

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