شرکت پژوهشگران نانو فناوری

# JIKAN

Surface Nano-Engineering

CAG-10

Contact Angle Goniometer

A spin off from **SNE** Research Center

Jikan CAG-10 is a drop shape analyzer. By placing drops on test samples and taking images, the CAG-10 calculates the wettability and surface free energy of the solid surface.

What is contact angle?

Consider the system shown below, consists of liquid, solid and gas phases. The intersection of solid, liquid and gas phases is called the contact line. The angle formed between the liquid-solid and liquid-gas interfaces is called the contact angle.
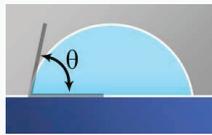
If the contact line moves during the measurement, the contact angle is dynamic contact angle. Otherwise, the angle is static contact angle.

On an ideal surface (smooth and homogeneous), the static and dynamic contact angles are equal.

On a real surface, the contact angle varies from a maximum (advancing) to a minimum (receding). The difference between advancing and receding contact angles is called the contact angle hysteresis.

Contact angle hysteresis determines the required force to shed a drop from the surface. Therefore, lower contact angle hysteresis signifies easier drop detachment.

Surface free energy is the work performed to expand the surface. The lower surface free energy leads to a lower wettability and more water repellency.

Surface classification

Water and oil represent two class of liquids, i.e. polar and non-polar.

Water:
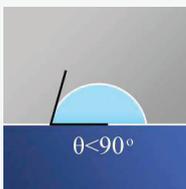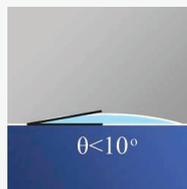
$\theta < 90°$
Hydrophobic

$\theta < 10°$
Superhydrophilic

$\theta > 90°$
Hydrophilic

$\theta_{Hysteresis} < 10°$ $\theta > 150°$
Superhydrophobic

Oil:

$\theta < 90°$
Oleophilic

$\theta > 90°$
Oleophobic

نشانی: تهران – خیابان توحید– خیابان ستارخان–خیابان مهران آفرند –پ ۱۱–طبقه اول. کدپستی:۱۴۴۱۶۴۳۹۴۳
شماره تماس: ۹۵۷۱۶۵۳-۰۹۲۱ – ۶۶۹۲۰۷۲۴-۰۲۱
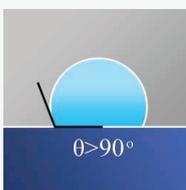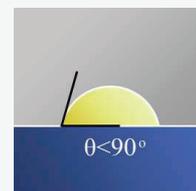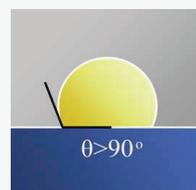
Engineered Surfaces Application

Superhydrophobic surfaces are self-cleaning as water drops easily bead up and roll off on these surfaces. As drop rolls off, it collects dust and dirt and carries them out. The superhydrophobic surfaces have various applications, e.g. drag reduction, corrosion inhibition, and heat transfer enhancement.

Superhydrophilic surface have applications in medical implants for biocompatibility improvement, anti-fog and anti-fouling applications and so on.

Oleophobicity has a wide application in self-cleaning paints, materials, glass and clothing.

Direct vs Indirect

In order to measure the contact angle there are two general methods:

Indirect methods find the contact angle by measuring the force (e.g. the Wilhelmy Plate method). Direct methods find the contact angle from the image (e.g. the Sessile drop method).

The direct methods are more common as they have higher precision and require less volume of liquid.

The sessile drop method and the tilting plate method are the main two methods to measure dynamic contact angles.

In the sessile drop method, the droplet is firstly injected on a horizontal sample, the injection continues and contact angle is measured during the contact line motion (advancing contact angle). The reverse procedure is used to measure the receding contact angle. For a smooth and homogeneous surface, the surface free energy could be calculated by the equation of state, through the sessile drop method.

In the tilting plate method, after the drop is formed on the surface, the stage (with the sample) starts to tilt. As soon as the drop starts to slide on the tilted surface, maximum (advancing) and minimum (receding) contact angles are recorded.

Measurment Methods

Pendant Drop [*]

Sessile Drop [*]

Dynamic Sessile Drop Advancing [*]

Dynamic Sessile Drop Receding [*]

Advancing Wilhelmy

Receding Wilhelmy

Captive Bubble [**]

Surface Energy

Spinning Drop

Tilting Base [**]
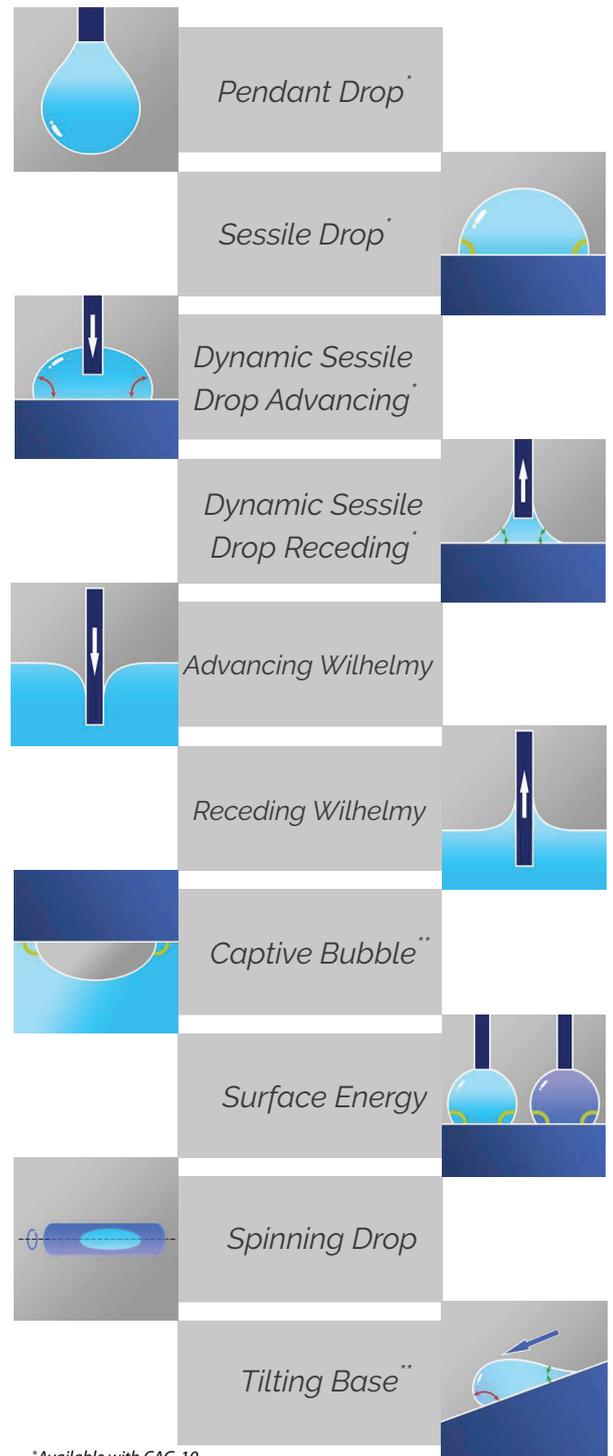
[*]Available with CAG-10
[**]Available with CAG-10 upon request

Jikan CAG-10 s a semi-automated contact angle goniometer with a user-friendly interface. Just a click is enough for the device to measure the contact angle. Our contact angle goniometer machines are equipped with Jikan Assistant software, which enables the user to measure the advancing and receding contact angles, contact angle hysteresis, surface tension of liquids and surface energy of solid surfaces.

Features

- Adjustable camera and sample holder

- Vibration free, accurate and reliable injection system

- Computer-controlled injection system

- Changeable syringes

- Levelable sample holder

- High speed, noise-free imaging system

- Changeable camera back to front angle
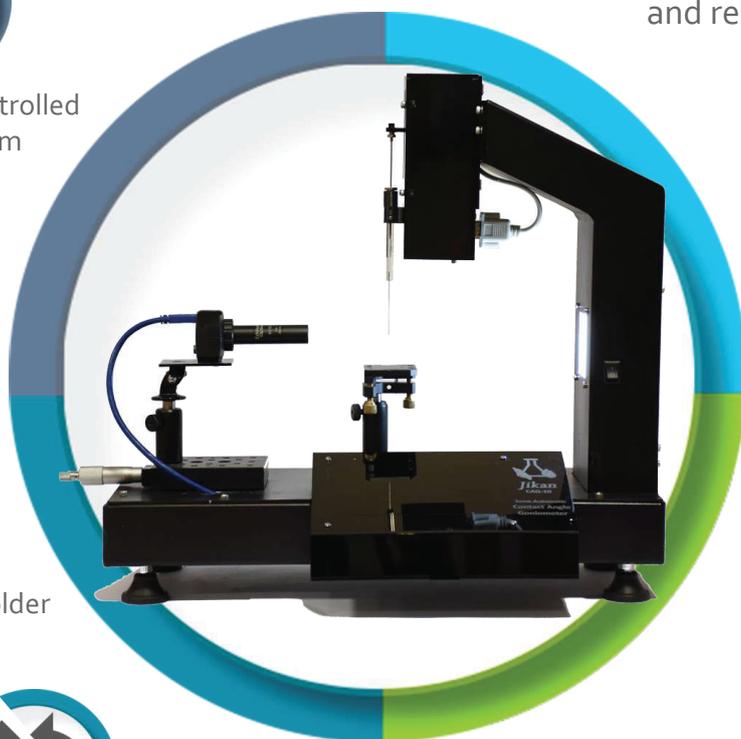
Mechanical Advantages

Authentic design of Jikan CAG-10 with stainless-steel body minimizes the mechanical vibrations and produces accurate results.

Camera Back to Front Tilt

This feature enables the user to see the reflection of drop and measure the contact angle accurately. The reflection is also needed to automatically detect the contact points. The tilt is engineered so that it does not produce any error in contact angle results.

Adjustable stage

In order to achieve maximum flexibility, Jikan CAG-10 stage has the ability to adjust in vertical and horizontal directions. This enables the user to test samples with maximum size of 150 (L) × 50 (W) × 25 (H) mm.

Stage Level

To test uneven samples, stage level enables the user to find a horizontal spot on the sample using this feature.

Injecting System

The injection system is designed to produce continuous injection of liquids with flow rates as low as 200 nl/s, and with no vibrations. The minimum attainable liquid volume with the standard injection system is 2.5 nl. This range is more than enough for measuring advancing and receding contact angles. The injection system is modular to simplify the repair or change with other systems we offer to meet your needs. The range and flow can be customized for specific applications.

Dispatchable Syringes

The syringe could easily be dispatched from the system so the fill-in, discharge and probable washing process could be easily done. The syringe and its holder can be completely replaced with other size syringes by the user.

Imaging system:

Imaging system plays a crucial role in the contact angle measurement, so the components of the system are selected with the highest quality models and brands. The camera is a 120 fps (optical) with a USB 3.0 connection for maximum speed of data transfer. The field of view completely covers the droplet area with a great accuracy. Jikan CAG-10 imaging system employs advanced imaging of the droplet which minimizes the perspective errors.
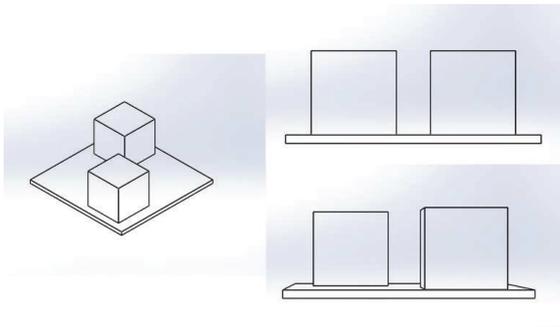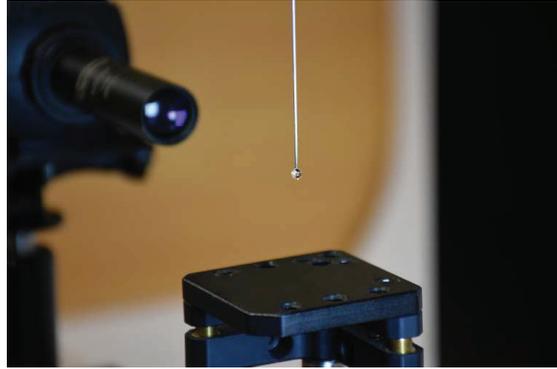

Minimizing Perspective Error

A hypothetical image of two identical cubes.
Up: imaged with telecentric lens.
Down: imaged with conventional zoom lens. The perspective error due to the separation of the cubes would lead to incorrect measurements.

Lighting system:

Proper lighting is a necessity to achieve an appropriate image of the droplet. Jikan CAG-10 uses a 450 nm lighting system to minimize the errors caused by ray diffraction. The intensity of the light is also easily adjustable by the user through the software.
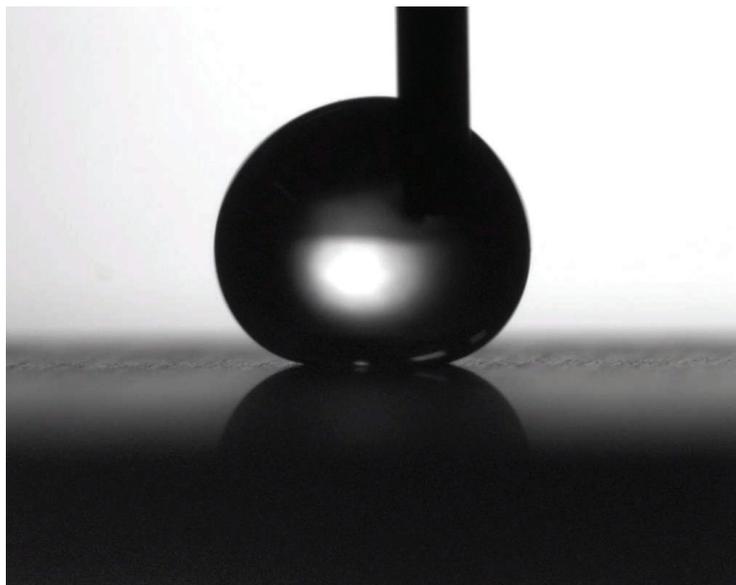
Jikan Assistant

The Jikan Assistant performs three major tasks: hardware control, automatic image brightness adjustments and image processing, to make a unique and easy experience for the user to measure the desired properties.

Image processing

User can choose from polynomial fit, circle fit, ADSA to measure the contact angle. The contact points can be found automatically or user can pick them manually. The live processing is added to evaluate the results as fast as possible. For a comprehensive data analysis off-line process can be performed as well.

Hardware control

Using hardware control, the injection rate can be adjusted to the recommended values for static and dynamics measurements as well as surface tension analysis.

Results appearance & data analysis

The collective data are shown in table and graph forms, along with the live analysis. Also the data, image and video can be saved separately and you can re-analyze them anytime you demand.

Imaging adjustments

You can choose the frame rate, exposure time, image resolution and illumination to obtain better results.

Modules

Environmental Chamber
for adjusting the temperature and humidity from -30°C to +90°C, and 0% to 100% accordingly.

Captive Bubble Chamber
for measuring the Young, advancing and receding contact angle of bubbles, instead of drops.

Tilt Plate Stage
for measuring the advancing and receding contact angles using tilt plate method.

Technical Data

Measuring Range | Inaccuracy	0° - 180° | ±0.1°
Camera System	Progressive CMOS Sensor |Global Shutter Up to 150fps Optical Frame Rate 1024×1280 Pixels | Pixel Size: 5.0 μm×5.0 μm USB 3.0 | Video Sequences
Optics	±1mm Working Distance Tolerance
Camera Back To Front Tilt	Manual
Lighting System	450nm Wavelength | No Heat LED
Camera Positioning Sample Holder Positioning	Manual X & Z Direction Move Manual Z Direction Move
Dispenser	Automatic Dispenser | Nanoliter Resolution
Jikan Assistant Software	Contact Angle & Surface Tension Measurement Module Included (Optional Surface Free Energy Measurement)
Computer Requirements	OS: Windows 8.1, 10 (32-bit & 64-bit) CPU: Intel Corei3 @ 1.3 GHz or Higher RAM: 2 GB or Higher | Disk Space: 2 Gb
Input | Power Supply	USB 3.0 |110/220 V, 50 W, AC
Size | Weight	60 cm × 25 cm × 55 cm | 12 Kg

Jikan Surface Nano-Engineering Company is a knowledge-based company based in Tehran, Iran. Jikan was established as a spin-off from SNE Research Center, University of Tehran. In Jikan, we manufacture world-class measurment instruments and perform top-notch research in the field of surface nano-engineering. Jikan is also a service provider and is well-known for its accurate, customizable, and quick services. We are in the process of developing new standards and protocols for our products and procedures, to secure our share both in domestic and international markets.

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