

DropMaster



**Versatile Dynamic Contact
Angle Meter**

Contact Angle, Surface Tension, Surface Free Energy

DM-series

A small droplet will shape characteristically lenticular if it is rested on a flat solid surface. The angle formed by the solid surface and the tangent to the droplet surface at the droplet end point is called *Contact Angle*. The *Contact Angle* is the primary data to indicate the degree of wetting when a solid and liquid interact.

Wetting is a phenomenon familiar with our daily life, but controlling the *Wetting* plays important roles in various industrial processes to create added values. For instances, antifogging mirror, water repellent clothes or paints, well drained asphalt not puddling, well absorbing skin lotion, etc. It is not too much to say that the technologies controlling the *Wetting* have achieved and supported our comfortable life.

Contact Angle Meter is an essential item to evaluate the *Wetting* precisely and intuitively, and has been adopted among wide variety of industrial fields.



Auger Electron Spectroscopy (AES), X-ray Photoelectron Spectroscopy (XPS) and Secondary Ion Mass Spectrometry (SIMS) are the major items for surface analysis. Adding evaluation by contact angle can characterize surfaces multilaterally.

Solutions of interfacial studies

Wetting

Permeance

Dispersion

Emulsification

Cohesion

Adhesion

Coating issues based on interfacial science

Stickiness

Peeling

Releasing

Cleanliness

Antifogging

Friction

KYOWA's mission is to provide our customers the optimal solutions from the viewpoint of interface science for various problems that occur on the surface and interface represented by the coating process. Among them, the contact angle meter is an effective instrument for analyzing and evaluating the cause of most interfacial phenomena.

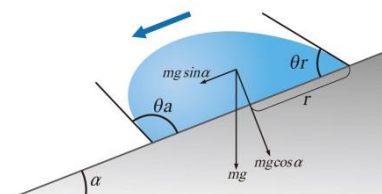
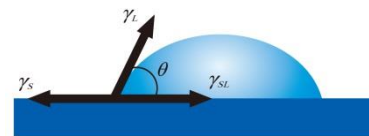
Principle

Contact angle basic ~ typical characterization of wettability between liquid and solid ~

A small droplet rested on a solid surface is formed by the equilibrium of the three surface and interfacial tensions as below, which is referred to as the Young's equation. The angle formed by the solid surface and the tangent to the droplet surface at the end point is contact angle.

$$\gamma_S = \gamma_L \cos \theta + \gamma_{SL}$$

γ_S solid surface tension
 γ_L liquid surface tension
 γ_{SL} solid/liquid interfacial tension
 θ contact angle



- α sliding angle
- θ_a advancing angle
- θ_r receding angle
- r radius of droplet basement
- m mass of droplet
- g acceleration of gravity

Sliding angle & Adhesive energy ~ characterization of hydrophobicity ~

If the solid surface is tilted by degree while a droplet is rested on it, the droplet starts sliding downward (or rolling off) at a certain degree. The tilt angle that the droplet starts sliding is referred to as Sliding Angle, and the contact angles at the lower and the upper ends are defined as Advancing Angle and Receding Angle respectively.

Adhesive Energy E is calculated with the equation as in the right in this status:

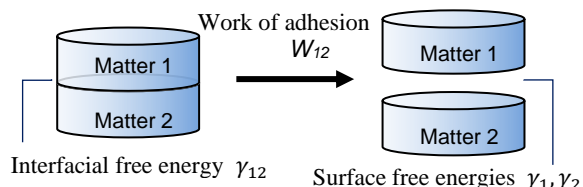
$$E = \frac{mg \sin \alpha}{2\pi r}$$

Surface free energy ~ for controlling wettability, adhesion ~

Solid surface free energy can be analyzed by contact angle data measured by some probe liquids, and it characterizes solid surfaces with components of energies. The most common approach is dividing into polar and dispersive components. Hydrogen bonding component, interaction affected by acid and base are also quantified depended on approaches. Those data can develop analyzing adhesive work and interfacial free energy of two matters. Those are significant information for characterizing wettability and adhesion.

The work of adhesion is defined as a reversible work to separate the interface of two matters as the figure in the right. The Dupré equation describes them as $W_{12} + \gamma_{12} = \gamma_1 + \gamma_2$. Besides, the work of adhesion W_{12} is defined by the approach of geometric mean as $W_{12} = \sqrt{\gamma_1 \gamma_2}$. When a solid and a liquid having polarity are contacted, the work of adhesion is described as $W_{SL} = \sqrt{\gamma_S^d \gamma_L^d} + \sqrt{\gamma_S^p \gamma_L^p}$, and also $W_{SL} = \gamma_L (1 + \cos \theta)$ by the Young-Dupré equation. Those give the equation:

$$\gamma_L (1 + \cos \theta) = \sqrt{\gamma_S^d \gamma_L^d} + \sqrt{\gamma_S^p \gamma_L^p}$$



With presence of contact angle θ by two probe liquids of known surface free energies γ_L^d, γ_L^p , unknown solid surface free energies γ_S^d, γ_S^p are obtained.

Applications

Target sample	Objective	Method
1) Paint, Ink, Film	Wettability Permeability	Static and dynamic contact angle Advancing / receding angles
2) Glass, Photocatalyst materials	Super hydrophilicity Super hydrophobicity	Static contact angle Sliding angle
3) Wax, Water repellent agent, Release agent	Hydrophilicity Exfoliation	Sliding angle Sliding speed
4) Adhesive, Coating film	Adhesiveness, Friction force	Surface free energy
5) Medicals, Pigment, Filler (powder)	Dispersibility Permeability	Dynamic contact angle Wetting speed
6) Flat panel, Wafer	Cleanliness Wettability	Static contact angle Surface free energy

Product lineup

DMo-902

Fully automated computer-controlled contact angle measuring system with 150x150mm 360° rotation stage



- Computer-controlled rotation stage with XY translation and rotation axis, and computer-controlled camera and dispenser unit with Z translation
- Fully automated mapping sequence (droplet generation → droplet deposition → droplet analysis → stage movement) over the full 150x150mm stage area is possible by pre-setting coordinates
- The optional multi dispenser system of up to five liquids allows for “one-click” fully automated analysis of the surface free energy
- The optional high capacity dispenser for one liquid allows for fully automated measurement of contact angles for applications with high liquid volume requirements
- The automatic recognition of droplet deposition enables droplet analysis after a pre-set time assuring reliable results under constant conditions

DMo-702

Fully automated computer-controlled contact angle measuring system with 150x150mm stage



- Computer-controlled stage with X translation and computer-controlled camera and dispenser unit with Z translation
- Automated measurement sequence (droplet generation → droplet deposition → droplet analysis → stage movement) in X-direction is possible by pre-setting commands
- The automatic dispenser unit generates droplets with high accuracy and assures precise measurements of advancing and receding angles through its constant volumetric flow rate
- The optional multi dispenser system of up to five liquids allows for “one-click” fully automated analysis of the surface free energy
- The automatic recognition of droplet deposition enables droplet analysis after a pre-set time assuring reliable results under constant conditions

DMo-602

Computer-controlled droplet dispensing and deposition of static and dynamic contact angles with 150x150mm stage



- Manual XY sample stage, and computer-controlled camera and dispenser unit with Z translation
- Automated measurement sequence (droplet generation → droplet deposition → droplet analysis) is possible by pre-setting commands
- The automatic dispenser unit generates droplets with high accuracy and assures precise measurements of advancing and receding angles through its constant volumetric flow rate
- The automatic recognition of droplet deposition enables droplet analysis after a pre-set time assuring reliable results under constant conditions
- The manual sample stage can be exactly adjusted to the desired position and the syringe of the dispensing unit can be changed quickly and easily

DMo-502

Computer-controlled droplet dispensing of static and dynamic contact angles with 150x150mm stage



- Manual XY sample stage, and manual camera and dispenser unit in Z-axis
- The manual sample stage can be exactly adjusted to the desired position and the syringe of the dispensing unit can be changed quickly and easily
- The automatic dispenser unit generates droplets with high accuracy and assures precise measurements of advancing and receding angles through its constant volumetric flow rate
- The automatic recognition of droplet deposition enables droplet analysis after a pre-set time assuring reliable results under constant conditions

DMs-401

Computer analysis of static and dynamic contact angles with 150x100mm stage



- Manual sample stage in X-axis and Z-axis for droplet deposition.
- The manual sample stage can be exactly adjusted to the desired position and the syringe of the dispensing unit can be changed quickly and easily
- The manual dispenser yet controls droplet volume with high accuracy thanks to the real time assist of droplet volume indication on image monitor.
- The automatic recognition of droplet deposition enables droplet analysis after a pre-set time assuring reliable results under constant conditions

DMe-211Plus

Computer analysis economical model of static and dynamic contact angles with 160x100mm stage



- Manual sample stage in Z-axis for droplet deposition.
- The 160 x 100mm wide stage allows repositioning the sample exactly to the desired position and the syringe of the dispensing unit can be changed quickly and easily
- The manual dispenser yet controls droplet volume with high accuracy thanks to the real time assist of droplet volume indication on image monitor.
- The automatic recognition of droplet deposition enables droplet analysis after a pre-set time assuring reliable results under constant conditions

Features in common for all models

- ◇ All models listed above performs sessile drop measurement in a function of time. Frame rate is depended on models.
- ◇ Standard droplet sample is provided as basic accessory for periodical pixel calibration and verification.
- ◇ Focusing aid with index graph and value displayed in the image screen helps operators to achieve perfect focus.
- ◇ Easily replaceable glass syringe and needle are used for both automatic and manual dispensers.
- ◇ Droplet depositing timing can be recognized automatically irrespective of stage operation by automatic or manual, which allows precise time function measurement.
- ◇ During analysis of the sessile drop, besides the contact angles, droplet volume, sessile drop volume, absorbed droplet volume, residual droplet ratio, height and radius of sessile drop are also determined.
- ◇ Measured results are displayed in a spreadsheet-like table for easy reference and comparison

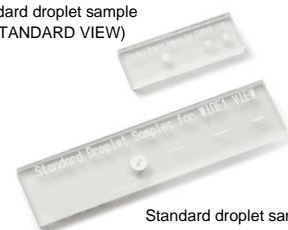
■ Basic configurations

	DMo-902	DMo-702	DMo-602	DMo-502	DMS-401	DMe-211+
Built in systems						
X-axis stage movement, motorized & manual	○	○				
X-axis stage movement, manual			○	○	○	
Y-axis stage movement, motorized & manual	○					
Y-axis stage movement, manual		○	○	○		
Z-axis stage movement, manual					○	○
Z-axis camera/dispenser unit movement, motorized & manual	○	○	○			
Z-axis camera/dispenser unit movement, manual				○		
Components and accessories						
Control box (DM)	○	○	○			
Automatic dispenser	○	○	○	○		
Manual dispenser	○	○	○	○	○	○
Standard droplet sample (standard view)	○	○	○	○	○	○
Syringe set 22G (5 each glass syringes, 22G SUS needles, springs and 10 washers)	○	○	○	○	○	○
Teflon coated needles, 2 each 18G & 22G	○	○	○	○	○	
Acrylic plate (for practice)	○	○	○	○	○	○
Add-in software						
Sessile drop (Static & dynamic)	○	○	○	○	○	○
Extension / contraction	○	○	○	○	○	
Surface free energy analysis	○	○	○	○	○	○
Pendant drop	○	○	○	○	○	○

■ Standard droplet sample as calibration standard

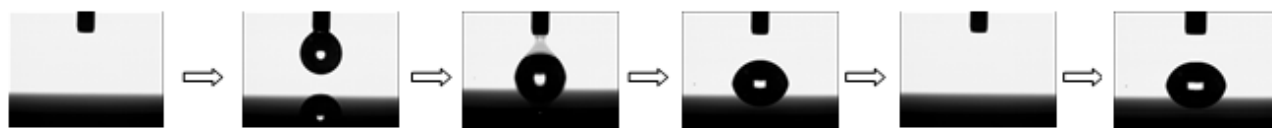
- The standard droplet sample (STANDARD VIEW) is a basic accessory for all models
- It is made of soda-lime glass bearing one full circle for calibration and three droplet silhouettes of 5°, 60° and 108° for periodic inspections of measurement accuracy
- With the help of this tool, users can easily perform routine maintenance to ensure reliability of their measurements over long periods of time
- A standard droplet sample for calibration of the camera wide-view setting, as well as standard pendant samples for standard view and wide-view setting can be obtained optionally
- A calibration certificate for the standard droplet sample is available optionally

Standard droplet sample (STANDARD VIEW)



Standard droplet sample (WIDE1 VIEW)

■ Measuring process



DM model	Positioning of first measurement point	Generation of droplet	Deposition of droplet (control/recognition)	Analysis of droplet	Positioning of next measurement point	150x150mm full scale continuous measurements
902	●	●	● / ●	●	●	●
702	▲ by command button	●	● / ●	●	●	▲
602	▲ by rotary knob	●	● / ●	●	▲	▲
502	▲ by rotary knob	●	▲ / ●	●	▲	▲
401	▲ by rotary knob	▲	▲ / ●	●	▲	▲
211+	▲ sliding sample itself	▲	▲ / ●	●	▲	▲

● automatic ▲ manual

■ Specifications

	DMo-902	DMo-702	DMo-602	DMo-502	DMs-401	DMe-211Plus
Camera system Speed & resolution	CMOS with 400fps at 640x480 pixels 500fps at 640x400 pixels 1000fps at 640x200 pixels 2700fps at 640x64 pixels ¹⁾				CMOS with 60fps at 640x480 px (option ¹⁾): 2700fps system as in the left)	CMOS with 30fps at 640x480 px
Optical system	manual focus with 3 step manual zoom					fixed focus
Field of view STD Wide1 Wide2	6.1x4.7 mm, 11.1x8.2 mm, 15.8x11.8mm ±6%				5.3x4.0 mm, 9.6x7.2 mm, 13.6x10.2mm ±5 %	about 6.3x4.7 mm
Measuring methods	1) contact angle by sessile drop method (static & dynamic) 2) advancing/receding angle by extension/contraction method and *sliding method 3) sliding angle and adhesive energy by *sliding method 4) surface/interfacial tension by pendant drop method 5) surface free energy analysis of solids *Sliding method is an option.					1), 4) and 5) in the left are available.
Analysis methods	contact angle: $\theta/2$, tangent, curve fitting (ellipse, circle) surface/interfacial tension: Young-Laplace, ds/de surface free energy of solids: Owens-Wendt, Kaelble-Uy, OWRK, Wu, Kitazaki-Hata, acid-base, Zisman liquids: OWRK, Wu					
Measuring range	contact angle: 0 to 180° surface/interfacial tension: 0 to 2000mN/m					
Resolution	contact angle: 0.01° surface/interfacial tension: 0.01mN/m					
Accuracy ²⁾	contact angle (C.A.): 0.2° surface/interfacial tension (ST/IFT): 0.2mN/m					C.A.: 0.3° ST/IFT: 0.3mN/m
Maximum sample size (W x D x H) weight	150x150x16mm 400g	150x150x35mm 400g			150x100x35mm 300g	160x100x10mm 300g
Stage operation X-axis Y-axis Z-axis Rotation axis	150mm (auto) 75mm (auto) --- 360°(auto)	150mm (auto) 75mm (manual) --- ---	150mm (manual) 75mm (manual) --- ---		150mm (manual) --- 40mm (manual) ---	--- --- 10.5mm (manual) ---
Dispenser operation Z-axis (drop deposition) Droplet generation Dispensing resolution	16mm (auto) auto 0.1µL	35mm (auto) auto 0.1µL		35mm (manual) auto 0.1µL	--- manual 0.1µL	--- manual 0.1µL
Measuring temperature	Ambient	standard: ambient optional: Jacket type temperature-controlled (+10 to +70°C) Heater type temperature-controlled (ambient to +180°C and ambient to +380°C) Peltier type temperature-controlled (-10°C to +100°C)				Ambient
Instrument dimensions (W x D x H)	297x544x305mm			294x544x305mm	294x461x288mm	170x346x283mm
Instrument weight	10.0kg	8.5kg		7.5kg	6.1kg	1.8kg
Control box dimensions (W x D x H, Weight)	290x240x100mm, 4.3kg			260x200x70mm, 1.6kg	---	---
Power supply	AC100~240V, 50/60Hz					USB bus power
	115W, 120VA			20W, 35VA	5.5W, 15VA	
Operating environment	Temperature: +10 to +35°C, humidity: 30 to 80%RH (non-condensing) Positioned away from sources of electrical noise and vibration					

¹⁾ 2700fps mode should be performed in the WIDE2 field of view and the optional standard droplet sample (WIDE1 VIEW) or standard pendant sample (WIDE1,2 VIEW) is required for pixel calibration.

²⁾ Accuracy is the repeatability in terms of standard deviation based on manufacturer's calibration standard

FAMAS software

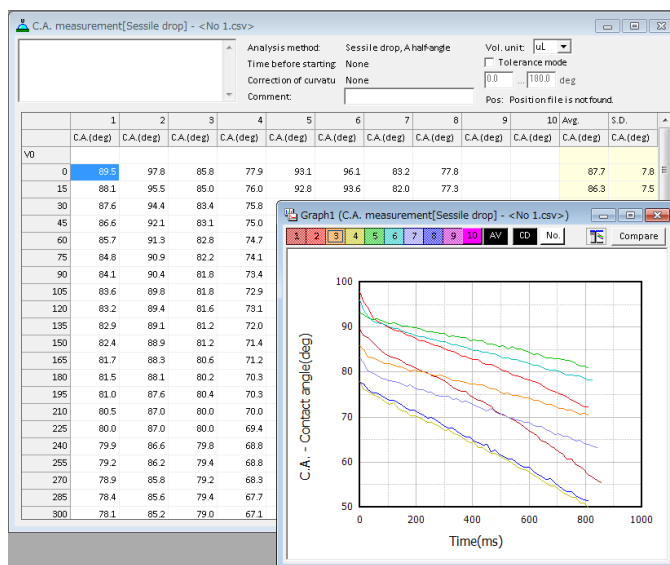
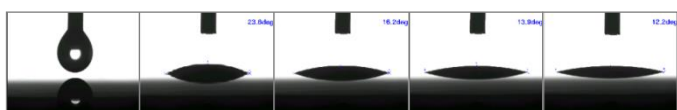
All the DM series contact angle meters are performed by the software FAMAS of the following major functions:



Sessile drop method - Fast image capture

The shape of water droplet deposited on a flat solid surface is often equilibrated in a second or so. But there are a lot of cases that the shape of droplet changes with time. Liquid evaporation, permeation, change of surface tension, or solid surface conditions cause the changes. In those cases, measurement of variations in a function of time is helpful. This fast image capture enables sequential capturing of the images and measures contact angle one by one, and plots the curve. Maximum frame rates are 2700, 60, or 30 fps depending on instrument model.

Application: Initial spreading, absorbing property, effect of surface active agents



Surface free energy analysis of solids and liquid

Surface free energies of both liquid and solid can be analyzed.

Solid analysis can be done by measuring contact angles of some probe liquids. Geometric mean propounded by Owens-Wendt, Kaelble-Uy, Kitazaki-Hata, Harmonic mean propounded by Wu, acid-base approach, Interaction analysis (Work of adhesion, Interfacial free energy), Young-Dupré, Zisman are available. OWRK method specified by ISO 19403-2 is performed as well.

Liquid analysis can be done by measuring either contact angles of some probe solids or interfacial tensions of some probe liquids. OWRK and Wu methods specified by ISO 19403-4,5 are performed. These analyses can be performed with the basic accessories of DropMaster series, purified water and a probe liquid (e.g. diiodomethane as a common one) as the least requirement. If no probe liquid is in your hand, optional FE kit, a set of probe liquids and needles, is recommendable.

Application: adhesive property, characterizing surface modification, quantifying hydrophilicity/hydrophobicity

Solid sample	CA(deg)						S.F.E. (mJ/m ²)							
	A	B	C	D	E	F	d	p	Total	Resid.	d	p	Total	Resid.
1) PP	102.0	84.7					33.4	0.1	33.5	0.0	34.1	0.0	34.1	0.0
2) PET	125.5	81.4					37.1	0.0	37.1	0.0	37.4	0.0	37.4	0.0
3) PE	101.0	81.1					36.5	0.0	36.5	0.0	36.5	0.0	36.5	0.0
4) PMMA	72.6	89.9					34.6	7.7	42.3	0.0	30.6	13.7	44.3	0.0



Surface/interfacial tension of liquids

Measurements of liquid surface tension (ST) and interfacial tension (IFT) of immiscible two liquids are possible by the pendant drop method specified by ISO 19403-3. Its advantages compared with conventional Wilhelmy plate and du Noüy ring methods are:

- ✦ small liquid amount (less than 10 μ L for each measurement prepared in a 1mL volume syringe)
- ✦ high temperature control (e.g. molten polymer applications)
- ✦ reactive solutions that should shorten air exposure

For measuring under normal pendant drop status, the glass cuvette is needed as the least item. For measuring under rising drop status, the glass cuvette and the inverted needle are the least items.

For fully performing this software, optional PD kit is recommendable. It is an accessory set including glass cuvettes, four sizes of regular and inverted needles, and standard pendant samples for verification.



Automatic recognition of drop deposition

The droplet deposition from the needle tip to the solid surface is recognized automatically. It enables to set time interval from deposition to determination of contact angle and keep timing precisely for every measurement. Especially for samples that spreads fast after depositing, this function is essential.



Sliding method (determination of Roll-off-angle and Hysteresis)

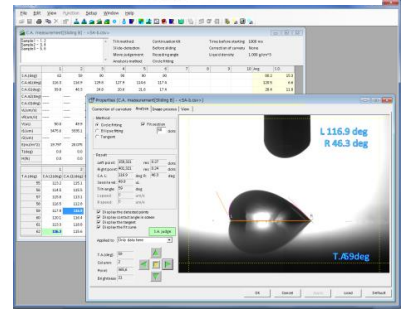
With the computer-controlled system which tilts the whole unit of contact angle meter, it enables to determine *Sliding Angle* (= *Roll-off-angle*, an angle of slope at which a droplet starts sliding or rolling off), *Advancing / Receding Angles* (lower / upper ends of droplet on the slope), its *Hysteresis* (difference between the two angles), and *Adhesive Energy* of the interface between liquid droplet and solid at a time.

KYOWA's sliding method allows the following advantages:

- ◇ In compliance with ISO 19403-7
- ◇ The system tilts whole unit to observe sensitive movement of droplet ends to determine the sliding angle and advancing / receding angles precisely.
- ◇ Droplet sliding is tricky. Some start moving from the lower end of slope, some do from the upper end contrary, and some others do both the ends together. This system can preset flexibly which end(s) of droplet are used for sliding judgement.
- ◇ Adhesive energy is good reference of hydrophobicity and lyophobicity.

The optional Sliding method kit and the add-in software are essential.

Applications: easy-to-clean or anti-adherent surfaces, hydrophobicity, lyophobicity



Dynamic sliding method

This is an evolutionary system to evaluate super hydrophobicity. The dynamic sliding method characterizes speed and acceleration of droplet sliding on a tilted stage by a certain angle while the sliding method characterizes the sliding angle and the adhesive energy. The system uses the sliding method kit as above in common and requires the dispenser X-Z positioning modular in addition.

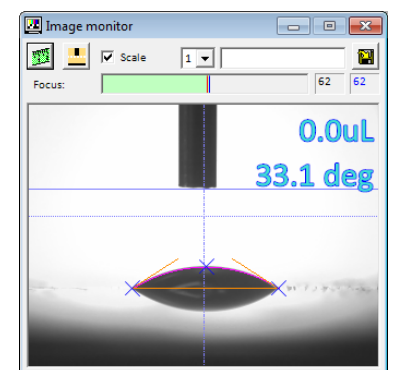
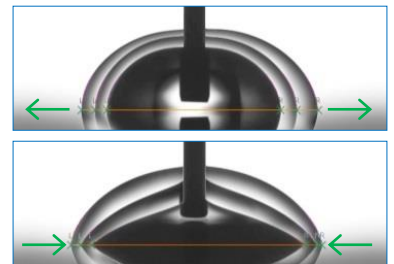
Application super anti-adherent surfaces



Extension/contraction method (determination of Hysteresis)

This method enables to determine *Advancing Angle* and *Receding Angle* in response to increasing and decreasing the droplet volume under the needle inside the droplet. Automatic dispenser is required for smooth and constant variations of droplet volume. In process of volume increasing, the droplet end moves outward and simulates a status of wetting to unwetted surface. It is *Advancing Angle*. Contrary, in process of volume decreasing, the droplet end moves inward and simulates a status of dewetting. It is *Receding Angle*. The difference between advancing and receding angles is referred to as *Hysteresis* and as a sign of chemical or physical homogeneity (morphology, topology) or roughness. This method follows ISO 19403-6.

Application: coating property, anti-adherent surfaces, characterization of hysteresis



Live image, droplet volume monitoring

The image monitor displays the live image of actual droplet, the values (droplet volume, contact angle), and the signs to determine the results (fitting curve or points, baseline and tangent line). When using the automatic dispenser, the droplet volume is controlled by software monitoring the live image.

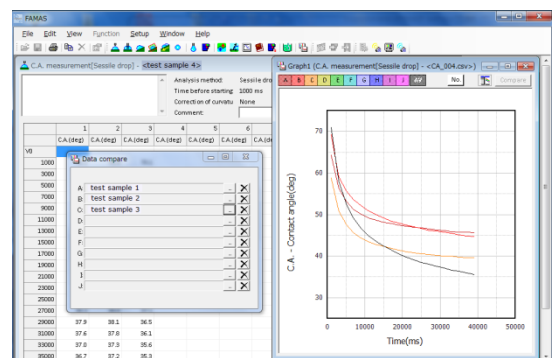
Brightness and focus adjustment

Thanks to the brightness level indicator and the focusing aid with index graph and value displayed in the image monitor, every operator can reproduce the same measurement conditions for those parameters.

Data chart & variable data

The measurement data obtained in a function of time can be plotted on a graph. Comparison of multiple data is possible between the individual data in a file and also between the average data of multiple files.

Besides the contact angle data, the droplet volume, sessile drop volume, absorbed droplet volume, residual droplet ratio, droplet height and radius are obtained at the same time.



■ **Optional accessories**

Jacket type climate chamber package

for DMo-702, -602, -502, DMs-401

For measuring contact angles from +10°C to +70°C
(capable wider temperature range depended on capacity of circulator)



Jacket type climate chamber set
set of jacket stage and the climate chamber cover
max sample size: 150x100x20mm



Surface thermometer Ø12, ST-51
to measure solid surface temperature
working temperature range from 0°C to +300°C



Hot/cold water circulator, 4VT
working temperature range from -10°C to +80°C
bath volume 3L

Heater type climate chamber package

for DMo-702, -602, -502, DMs-401

For measuring contact angles from ambient to +180°C



Heater type climate chamber set

- Set of heater stage and the climate chamber cover
- Maximum sample size: 150x100x20(T)mm

PID temperature controller 202

- Working temperature range: 0°C to +200°C
- Two built-in type K thermocouples

Heater type stage package

for DMo-702, -602, -502, DMs-401

For measuring contact angles from ambient to +380°C
Specially used for higher temperature application with the heater type dispenser



Heater stage set

- Set of heater stage and the cover
- Maximum sample size: 80x40x20(T)mm

PID temperature controller 402

- Working temperature range: 0°C to +400°C
- Two built-in type K thermocouples

Jacket type chamber package

for DMo-702, -602, -502, DMs-401

For measuring surface/interfacial tension from +10°C to +70°C
(capable wider temperature range depended on capacity of circulator)



Jacket type chamber set
set of jacket chamber and the cover
can accommodate one glass cuvette,
inner dims. 20x20x28(H)mm (Part no. 713)



Surface thermometer Ø1.6, ST-41
to measure solid liquid temperature
working temperature range from 0°C to +300°C



Hot/cold water circulator, 4VT
working temperature range from -10°C to +80°C
bath volume 3L

Heater type chamber package

for DMo-702, -602, -502, DMs-401

For measuring surface/interfacial tension from ambient to +380°C



Heater type climate chamber set

- Set of heater stage and the climate chamber cover
- can accommodate one glass cuvette, inner dims. 20x20x28(H)mm (Part no. 713)

PID temperature controller 402

- Working temperature range: 0°C to +400°C
- Two built-in type K thermocouples

Heater type dispenser package

for DMo-702, -602, -502, DMs-401

For heating liquid sample from ambient to +380°C
(higher temperature application)

Heater type dispenser set

- Set of heater dispenser, its holding arm* and stand
- To control temperature of liquids and to melt polymers, waxes and solders
- With holding arm for models of DMo-series or DMs-401



PID temperature controller 402

- Working temperature range: 0°C to +400°C
- Two built-in type K thermocouples

Single automatic dispenser system, AD-301s

for DMs-401

- 1 single automatic dispenser for 1mL syringe
- 1 dispensing controller
- DMO-series include the equivalent dispenser basically.



Multi automatic dispenser system, MAD-351

for DMO-902, -702, -602, -502

Computer controlled dispenser system capable to set up to 5 kinds of liquid dispensers. When connecting this system to DMO-902 or DMO-702, all the processes of selecting dispenser and deposition of droplet can be preset and performed fully automated.

- 1 automatic rotary holder capable up to 5 dispensers
- 3 automatic single dispensers
- 1 dispensing controller



Control box

* For DMO-502 and DMs-401, the control box must be ordered separately

Three state measurement kit (145mL)

for DMO-902, -702, -602, -502, DMs-401

Kit for contact angle in bulk liquid phase (**Captive bubble method**)

- 1 glass cell (silica), capacity: 145mL
- 1 sample stage, inverse for depositing rising droplet or bubble
- 1 sample stage, regular
- 2 inverted SUS needles 22G
- 3 magnets

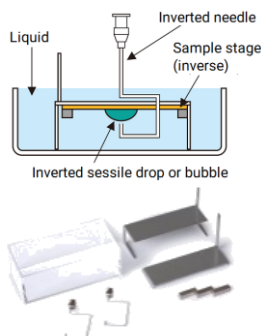


Image capture system 02

for DMs-401

USB 3.0 CMOS with max. 2700fps

- Frame rates and resolutions:
- 400fps at 640x480 pixels
 - 500fps at 640x400 pixels
 - 1000fps at 640x200 pixels
 - 2700fps at 640x64 pixels



Sliding method package

for DMO-902, -702, -602, -502, DMs-401

Sliding method kit

External automatic tilting stage to tilt whole contact angle meter unit
Tilt range: 0° - 90°.

*Using it on DMO-902 narrows max 45°
Tilt speed: 0.1 - 5.0°/sec.



Standard droplet sample (WIDE1 view).

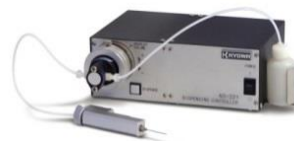
* For DMO-502 and DMs-401, the control box must be ordered separately



Large capacity pump dispenser, AD-321

for DMO-902, -702, -602, -502, DMs-401

- For use of large numbers of measurement repetitions
- Incl. 50ml liquid container
- For DMO-502 and DMs-401, the control box must be ordered separately.



Multi manual dispenser set, MMD-150

for DMO-902, -702, -602, -502

Manual dispenser system capable to set up to 5 kinds of liquid dispensers.

- 1 manual rotary holder capable up to 5 dispensers
- 3 manual single dispensers



FE kit

for DMO-902, -702, -602, -502, DMs-401, DMe-211Plus

Useful kit for starting surface free energy analysis

- 5 probe liquids, 25mL or 25g each (hexadecane, α -bromonaphthalene, diiodomethane, ethylene glycol, formamide)
- 4 Teflon coated needles 18G



PD kit

for DMO-902, -702, -602, -502, DMs-401, DMe-211Plus

Kit for measuring liquid surface or interfacial tension by pendant drop method

PD kit (STD & WIDE) (for DMO-series and DMs-401)

- 5 glass cuvettes
- 1 light-shielding cover
- SUS needles (28, 22, 18, 15G x2 each)
- Inverted SUS needles (28, 22, 18, 15G x2 each)
- Pendant drop calibration standards (standard view) and (wide1 · 2 view)



PD kit (STD) (for DMe-211Plus)

Same as above but excluding Pendant drop calibration standard (wide 1, 2 view)



Dynamic sliding method kit

for DMO-702, -602, -502, DMs-401

In addition to Sliding method package, the following kit and add-in software are required:

- Add-on module of 2D sliders for positioning dispenser
- FAMAS add-in software [Sliding C]



Double dispenser system, AD-302Wo, -302Ws

for DMO-902, -702, -602, -502, DMS-401

Computer controlled double dispensers and their changeover system.

Consists of:

- 2 automatic dispensers for 1mL syringe
- 1 dispensing controller
- AD-302Wo for DMO-series and AD-302Ws for DMS-401 are available.



Peltier type climate chamber package

for DMO-702, -602, -502, DMS-401

Temperature control system of Peltier module for measuring contact angle

Working temperature range: -10°C to +100°C with basic system


Consists of:

- Peltier type climate chamber set
- Peltier module controller & built-in circulator
- Surface thermometer ST-51



■ Specialty contact angle meters

Besides the versatile models appeared in this brochure, the items for specialty applications are available:

Wafer Cleanliness and Treatment Analyzer DMO-902WA, DMO-702WA, DMO-502WA	Microscopic Contact Angle Meter MCA-4
<p>Mainly applicable to round shape samples like wafer and disk of the diameter up to $\phi 12$ inches. According to the stage automation grade, 3 models DMO-902WA, -702WA, -502WA are available.</p>	<p>Using $\phi 5\mu\text{m}$ capillary, super small droplet of tens of μm diameter (tens of Pico liters in volume) can be discharged for micro area measurements. Optional ink-jet system is available.</p>
<p>Portable Contact Angle Meter PCA-11</p> <p>Hand-held portable type with fully automated measurement which is used by placing the body on sample to be free from sample size restriction.</p>	<p>Flat Panel Contact Angle Meter FPD-CP11</p> <p>It is designed to be performed as an equipment on Q.C. equipment typically in the process of large flat panels and semiconductor wafers.</p>
DyneMaster Tensiometer, DY-700, DY-500	
	<p>DyneMaster series are KYOWA's balance type tensiometers. Wilhelmy plate method and du Noüy ring method are performed for determining surface / interfacial tension. The above models allow the following functions at option:</p> <ul style="list-style-type: none">◇ Dynamic contact angle by Wilhelmy plate method◇ Powder contact angle (liquid infiltration to powder) by Washburn formula

Please contact our sales partner or us directly at +81-48-483-2629 or at overseas-sales@face-kyowa.co.jp

Specifications and designs are subject to change without notice

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