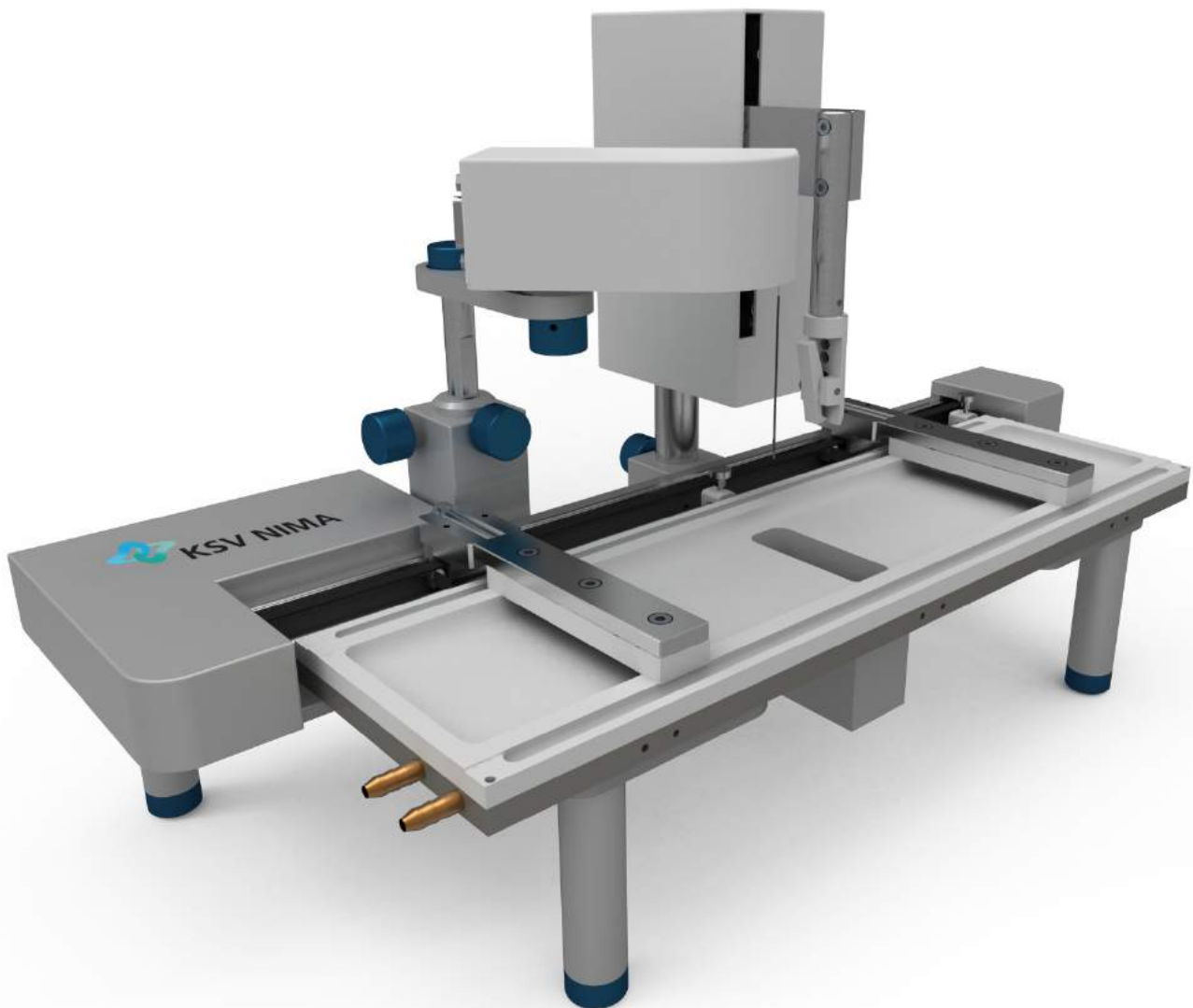


Langmuir and Langmuir-Blodgett Deposition Troughs



Thin Film Coatings with Controlled Packing Density

Sophisticated Thin Film Technology

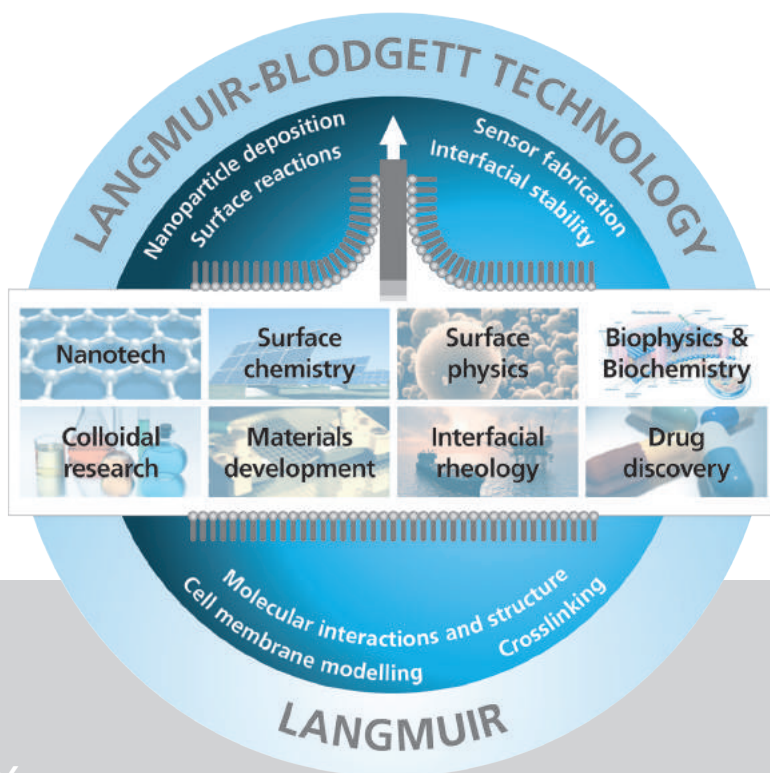
Thin film coatings

Coatings and thin films made from nanoparticles are gaining recognition and use in various products and applications including displays, sensors, medical devices, energy storages and energy harvesting. The challenge to achieve a homogenous coating fulfilling the requirements of optimized packing density, particle organization and film thickness is well-known.

One of the most sophisticated techniques for creating thin films and coatings of nanoparticles are Langmuir-Blodgett (LB) and Langmuir-Schaefer (LS) supplied by KSV NIMA.

Biomembrane modelling

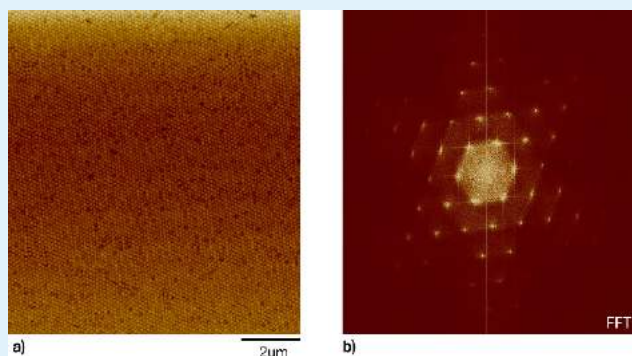
Langmuir technology is a unique method for studying biomembranes. The effect of for example pharmaceuticals or toxins to the biomembrane can be followed real time. Membrane structure and changes in its properties can be characterized further in the presence of proteins or peptides.



THIN FILM COATINGS WITH CONTROLLED PACKING DENSITY

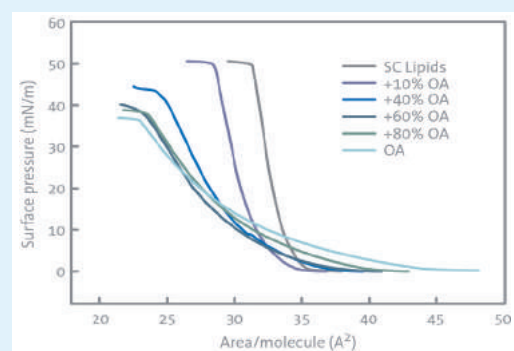
[APPLICATION EXAMPLES]

Controlled nanoparticle and graphene deposition



A monolayer of 200nm-diameter polystyrene nanospheres deposited on a quartz substrate using the Langmuir-Blodgett technique on a KSV NIMA Medium trough. (a) AFM image of the monolayer, (b) a Fourier transform of the same image exhibiting the exceptional crystallinity achievable with this technique. Copyright Dr. Alaric Taylor.

Unique tool for biomembrane modelling



THE ISOTHERMS OF MODEL SKIN LIPIDS WITH INCREASING LEVELS OF OLEIC ACID. With permission from Langmuir 2013, 29 (15), pp 4857–4865. Copyright 2013 American Chemical Society.

How to create thin films

Floating thin films - Langmuir solution

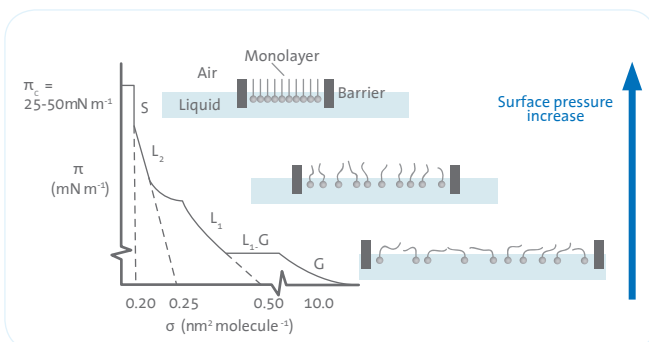
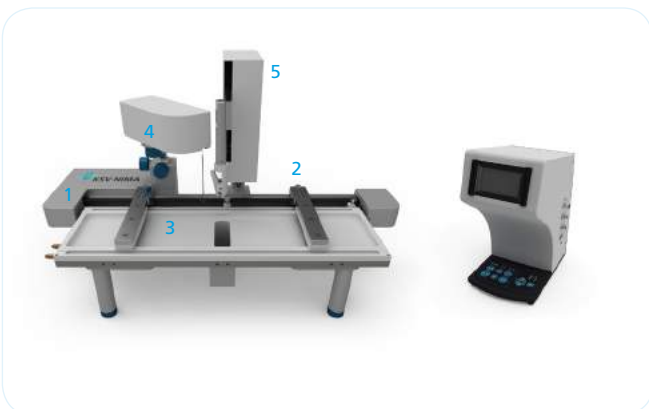
KSV NIMA Langmuir Troughs are used for creating, modifying and studying floating Langmuir films. A Langmuir film can be defined as an insoluble monolayer of functional molecules, nanoparticles, nanowires or microparticles that reside at the gas-liquid or liquid-liquid interface.

A Langmuir film is created by depositing material on an aqueous subphase confined in a shallow chamber called trough top (3). The monolayer is then compressed with a set of barriers (2) to reduce the mean molecular area each molecule has. The surface pressure thus the packing density is monitored via the pressure sensor (4) of the Langmuir Trough.

As a result the surface pressure-area isotherm provides information on the average area per molecule, the interactions between the molecules and the compressibility of the monolayer. The isotherm typically shows a phase of weak intermolecular interactions (gas phase, G), a phase of higher interaction (liquid phase, L) and a phase of high solid dense interaction (solid phase, S).

Creating Langmuir films enables for example the study of

- Monolayer structure and interactions
- Molecular adsorption kinetics
- Phase transitions
- Surface reactions with an injected material
- Interfacial viscoelastic properties



Coated thin films: Langmuir-Blodgett deposition

KSV NIMA Langmuir-Blodgett Deposition Troughs (LB Troughs) have the same capabilities as KSV NIMA Langmuir Troughs as they also enable Langmuir film fabrication and study. As an additional capability, the thin film formed can now be coated on a solid substrate to create a coating of highly organized particles.

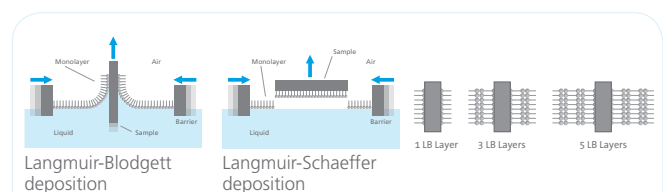
An LB trough is equipped with a dipping well and a dipping mechanism (5) that are used for transferring the film with the desired packing density. Typical deposited films include nano-particles, graphene, lipids, polymers, microparticles and various functional organics. The coating can be made vertically (Langmuir-Blodgett) or horizontally (Langmuir-Schaeffer) depending on the configuration.

Additional characterization methods such as Brewster angle microscopy can be used prior to deposition to ensure a good thin film quality to facilitate the deposition.

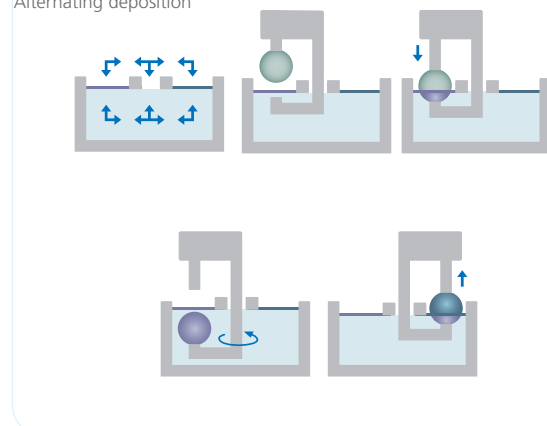
Nanoscale films of custom thickness can be built up by repeating the deposition.

Langmuir-Blodgett coatings have unique advantages such as:

- Precise control of molecular packing density
- Precise control over coating thickness
- Homogeneous deposition over large areas
- Enables multilayer structures with varying layer composition
- High flexibility to use different kind of particles and substrates
- Coating quality can be pre-monitored prior to deposition



Alternating deposition



KSV NIMA Langmuir and Langmuir-Blodgett Troughs

KSV NIMA Langmuir and Langmuir-Blodgett Troughs are the ultimate tools for effective thin layer coatings and studies. They combine the knowhow based on over 30 years of experience in working with Langmuir films. The systems have been designed to be extremely versatile and robust to ensure high quality results.

High quality coatings

- Controlled packing density
- Controlled layer thickness
- High flexibility for particles and substrates
- Large areas can be coated
- Multilayer coatings with different materials

Floating membranes and monolayers

- Biomembrane modelling
- Pharmaceuticals and toxins
- Molecular properties
- Monolayer interactions
- Phase transitions
- Interfacial viscoelastic properties

Quality

Single piece solid PTFE trough tops including the dipping well enable easy cleaning without any contaminating glues or coatings.

Adjustable legs, trough top locating pins, barrier limit switches and overflow channels ensure safe and reliable use of the system.

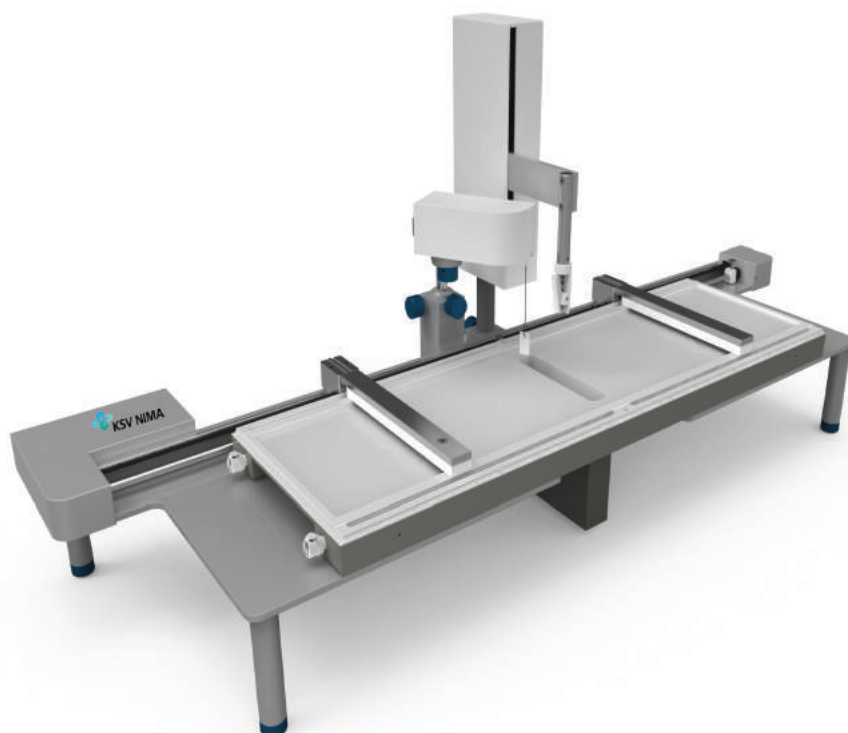
Usability

Uses standardized Wilhelmy method with platinum plate for surface pressure sensing with its ultra-sensitive pressure sensor, with the option to use also disposable paper plates to avoid cleaning.

Powerful KSV NIMA LB software integrates all controls and data analysis into the same software, including different characterization tools. All troughs come with integrated temperature control channels which can be used with a separate bath circulator.

Versatility

Specialized characterization tools enable ensuring floating thin layer quality already prior to coating and after the coating process. Open modular design with simple trough top and barrier placement enables easy integration to characterization systems, upgradeability and easy cleaning of parts.





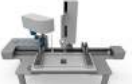










Troughs For Every Need

Selection of Langmuir and Langmuir-Blodgett systems

KSV NIMA offers a wide selection of L&LB Troughs with various sizes and functionalities. Our L&LB systems are fully modular, and one frame can be used for different sizes and types of trough tops.

In addition to the standard offering below, custom trough tops can be created by request. Detailed specifications for each size are available in the specification chart (last page).

Small	Medium	Large	High Compression	Alternate
Langmuir Troughs				
 KN 1002	 KN 1003	 KN 1006	 KN 1005	
Langmuir-Blodgett Deposition Troughs (A = Alternate)				
 KN 2001	 KN 2002	 KN 2003		 A = KN 2006
Microscopy Troughs (U = upright, I = inverted)				
 U = KN 3001	 I = KN 3003			
Ribbon Barrier Troughs (L = Langmuir, LB = Langmuir-Blodgett)				
	 L = KN 1007 LB = KN 2005			
Liquid-Liquid Troughs				
	 KN 2007		 KN 1004	
STANDARD FRAME		LARGE FRAME	HIGH COMPRESSION FRAME	ALTERNATE FRAME

[SPECIALTY SYSTEMS]

Alternate Coating Trough

- KSV NIMA Alternate Trough is the premium Langmuir-Blodgett Trough
- Capable of coating a substrate automatically using two different materials simultaneously
- Even more advanced highly organized coatings
- Materials can be deposited in any desired order
- Uses two sets of barriers and pressure sensors to control packing density separately

Liquid-Liquid Troughs

- Extends the capability to use both liquid-liquid and air-liquid interfaces
- Emulsion stability and properties
- Oil & gas, food, cosmetic, pharmaceutical

Microscopy Troughs

- Combine Langmuir to a microscope for additional characterization
- Morphology, phase changes, adsorption
- Visible light or UV microscopy
- Different options for upright and inverted microscopes

High Compression Trough

- Extended compression ratio
- For molecules with high compressibility such as phospholipids
- Extended room to combine with characterization tools

Ribbon Barrier Trough

- Lung surfactant application
- Other applications where extremely high surface pressures needed
- PTFE-coated glass ribbon prevents any leakages that could occur in high pressures

Custom Troughs

- Custom Troughs offered regularly to meet your needs
- Custom dimensions, shapes, materials or applications

Accessories and Characterization

KSV NIMA offers a wide selection of additional tools to assist in your studies. Examples include:

For thin film coatings:

- Langmuir-Schaeffer holder for horizontal deposition
- MicroBAM microscope for floating Langmuir film quality inspection prior to the deposition
- Temperature control and monitoring for controlled deposition environment
- pH measurement probe for monitoring deposition liquid

For Langmuir studies:

- Surface Potential Meter (SPOT) for molecular orientation studies
- Injection port for adsorption studies
- Interfacial Shear Rheometer for emulsion and foam stability studies
- PM-IRRAS spectrometer for chemical composition and molecular orientation studies



KSV NIMA SPOT



KSV NIMA ISR

KSV NIMA LB Software

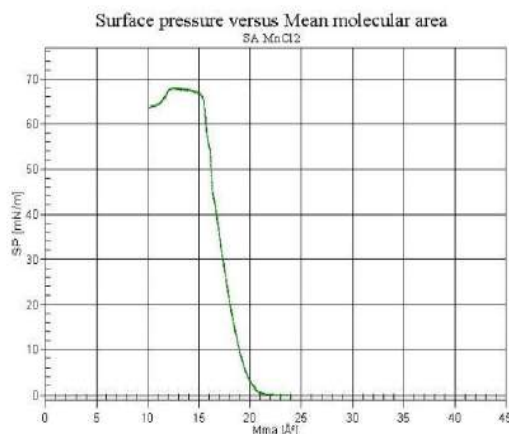
KSV NIMA LB software is a powerful tool for creating coatings and studying Langmuir films. Based on 30 years of experience, KSV NIMA LB software includes all the tools needed for effective and easy measurements and data handling.

The versatile measurement modes enable measurements from dipping all the way to compression isotherms, adsorption studies and interfacial rheology.

The measurement features include:

- **Coating mode**, for depositing material layer, including a coating effectiveness parameter transfer ratio, keeping the packing density constant throughout the dipping
- **Compression/relaxation isotherms**, for molecular interactions and phase changes
- **Isochores/isobars**, by keeping the pressure stable automatically and following temperature/area changes
- **Monolayer kinetics**, for enzyme, polymerization or any other zero-order reactions
- **Adsorption and penetration** of enzymes, proteins, peptides and similar molecules
- **Interfacial rheology**, for viscoelastic studies of Langmuir films, for emulsion or foam stability, with oscillating barriers method
- **Integrated KSV NIMA characterization tool functions**, for easy integration, for example automatic picture taking based on surface pressure when combined to KSV NIMA MicroBAM

The software saves the entire measurement setup together with the results for convenient analysis. All data can be easily viewed, plotted, reported and exported as needed.



Screen shoot KSV NIMA LB software; Surface pressure against mean molecular area for steric acid in water - MnCl₂

For a complete accessory description, please visit <http://www.biolinscientific.com/ksvnima/products/>

KSV NIMA Thin Film Coating Solution

Powerful tool for nanoparticle coating creation

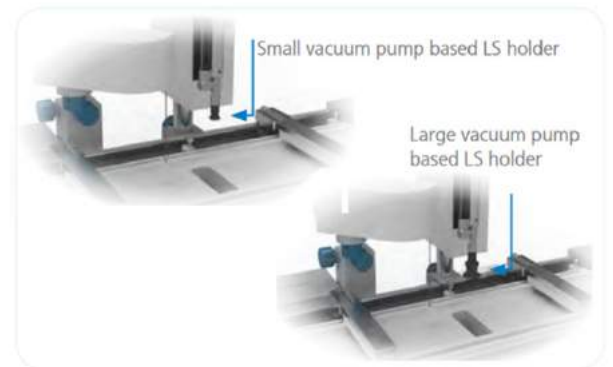
KSV NIMA Thin Film Coating package is a readymade solution for creating for example highly controlled nanoparticle coatings. It includes all the required standard tools for effecting deposition and comes with a great package value.

The package enables

- Vertical Langmuir-Blodgett coatings
- Horizontal Langmuir-Schaeffer coatings
- Pre-deposition film quality check with a Brewster Angle Microscope
- Isotherms and other Langmuir studies for floating film properties and molecular/particle interaction studies

Main benefits of using KSV NIMA Thin Film Coating Solution

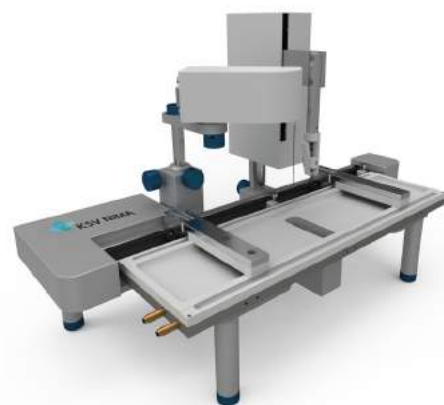
- Precise control of the monolayer (thin film) thickness and packing density
- Homogeneous deposition over large areas
- Enables multilayer structures with varying layer composition
- Deposition can be made on any kind of solid substrate
- Brewster Angle Microscope ensures molecular layer quality prior to the deposition



Langmuir-Schaeffer holders



KSV NIMA MicroBAM



KSV NIMA Langmuir-Blodgett Medium Trough

[SPECIFICATIONS AND COMPATIBILITY CHART]

	Small	Medium	Liquid-Liquid Medium	Large	Liquid-Liquid High Compression	High Compression	Alternate
Surface area (cm ²)	98	273	269 (197*)	841	580 (423*)	587	586 (x2**)
Trough top inner dimensions (L x W x H mm)	195 x 50 x 4	364 x 75 x 4	364 x 74 x 7 (364 x 54 x 10*)	580 x 145 x 4	784 x 74 x 7 (784 x 54 x 10*)	782 x 75 x 5	782 x 75 x 5 (x2**)
Maximum compression ratio	5.2	10.8	10.8	18	24.7	24.7	3.9
Barrier speed (mm/min)	0.1...270	0.1...270	0.1...270	0.1...270	0.1...270	0.1...270	0.1...270
Balance measuring range (mN/m)	0...300	0...300	0...300	0...300	0...300	0...300	0...300
Maximum balance load (g)	1	1	1	1	1	1	1
Balance resolution (µN/m)	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Langmuir trough top	•	•	-	•	•	•	-
Total subphase volume (mL)	39	109	-	336	406 (212*)	293	-
Langmuir-Blodgett trough top	•	•	•	•	-	-	•
Total subphase volume (mL)	57	176	450	578	-	-	1400
Dipping well dimensions (L x W x H mm)	20 x 30 x 30	20 x 56 x 60	20 x 54 x 60	20 x 110 x 110	-	-	Half a circle, radius 75; depth 74
Maximum sample size (T x W x H mm)	3 x 26 x 26 (1 inch)	3 x 52 x 56 (2 inches)	3 x 50 x 56	3 x 106 x 106 (4 inches)	-	-	3 x 30 x 50
Dipping speed (mm/min)	0.1...108	0.1...108	0.1...108	0.1...108	-	-	0.1...108
Upright microscopy trough top	•	-	-	-	-	-	-
Inverted microscopy trough top	-	•	-	-	-	-	-
Ribbon barrier trough top	-	•	-	-	-	-	-
Compatible with							
KSV NIMA PM-IRRAS	•	•	-	•	-	•	-
KSV NIMA ISR	-	-	-	-	•	•	-
KSV NIMA MicroBAM	-	•	-	•	-	•	•
KSV NIMA BAM	-	-	-	•	-	-	-
KSV NIMA SPOT	-	•	•	•	-	•	-

* The Liquid-Liquid Trough is deeper than a standard trough as this allows for the two liquid phases. The value in the brackets corresponds to confinement of the lower phase (other value for the upper phase).

** The Alternate-Layer Deposition Trough is made of two separated compartments for creation of two monolayers simultaneously.

• : available
- : not available/not applicable



Each of these four colours used in the table correspond to one frame.
All trough tops labelled with the same colour can be placed on the same frame, for modularity.



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[Progress Together]

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Biolin Scientific is a leading Nordic instrumentation company with roots in Sweden and Finland. Our customers include companies working with life science, energy, chemicals, and advanced materials development, as well as academic and governmental research institutes. Our precision instruments help develop better solutions for energy and materials, and perform research at the frontiers of science and technology.