QSense Pro

Large-scale QCM-D Analysis

Biolin Scientific
Empowering Innovators

Join the QSense Community

Investing in a QSense® QCM-D instrument is an excellent choice providing you with a premium system for measurements of surface interactions at the nanoscale. We invite you to learn more about the many benefits of our most high-end instrument QSense Pro, and to join the QSense community.

By Scientists for Scientists

The foundation for the first commercial QCM-D instruments was created by Scientists in a laboratory at Chalmers University of Technology in Sweden in the 90s. A lot has happened since the first prototype, the QSense instrument range has grown wider alongside the interest for the technology from the scientific community. Today, the instruments are used at research facilities worldwide and in a vast variety of applications within areas such as pharmaceuticals, biotechnology, energy, and electronics.

QSense in numbers

- In academic and industrial labs since 1999
- More than 1000 installed instruments in 50+ countries
- Mentioned in 3000+ publications
- Over 200 customized sensor coatings developed for customers

QSense Pro

QSense Pro is the premium option for large-scale QCM-D analysis. The fully automated system provides you with high quality data and reproducible results with its user-independent operation.

Most suitable when:

You need maximized throughput
The 8-channel system can produce a lot of data every day.

You want to test and compare samples
8 channels and 4 separately controlled syringe pumps let you evaluate several samples and parameters in one go.

You need highly reproducible results
The fully automated system minimizes human errors and maximizes user-independence.

You want to conduct experiments in both high and low temperatures
The instrument works with a temperature range between 4-70 °C.

You need more time
The system can be pre-programmed and left unattended during experiments, leaving you with time to do other things.

3 reasons to invest

Increased productivity

The 8 channels of QSense Pro give you an opportunity to be fast and to produce lots of data every day. The fully automated system can be pre-programmed and left unattended during experiments, saving your time.

Compare several samples at the same time

Syringe pumps that run separately enable 4 channels to be used independently with different samples and measurement sequences. Hence, you can evaluate several parameters in parallel.

Highly reproducible results

Automated measurements decrease the risk of user dependency and give you more reproducible results. Also, high precision flow-control is ensured by syringe pumps. Programming of automated mixing, including gradients of samples, increases reproducibility.

What our customers say

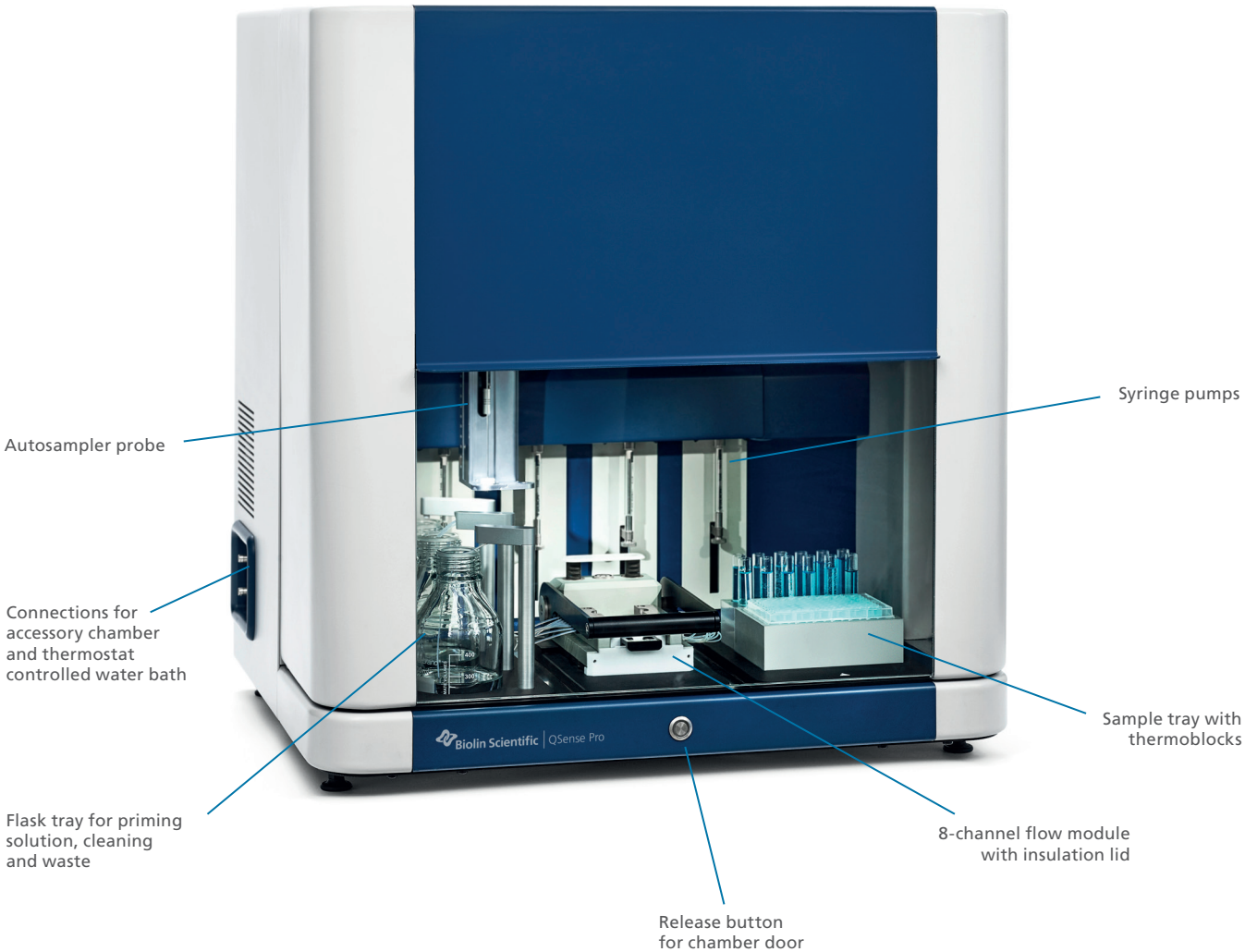
"We can monitor the mass change of our system in real-time. I can tell you that for every electron moved, this amount of mass changed. That's powerful. You can't really get that with any other system."

Jodie Lutkenhaus,
Associate Professor,
Texas A&M University, US

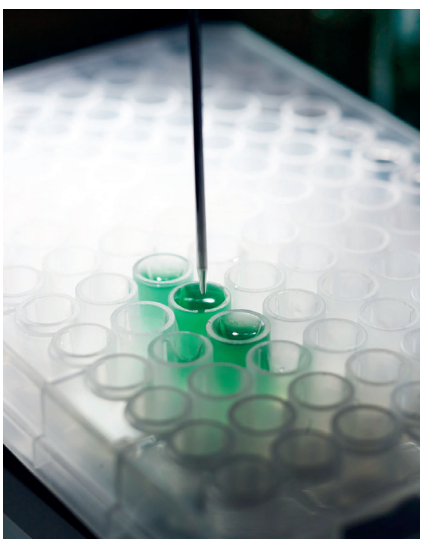
Pro Features

Let's take a closer look at the most advanced QCM-D instrument on the market. Automation and smart functions create an efficient system with high throughput and reproducible results. QSense Pro is designed to save valuable time and simplify your work in the lab.

- **Fully automated liquid handling**
  Pre-programming and full automation allows for unattended measurements with high reproducibility
- **High throughput**
  Up to 8 measurements can be programmed in advance to reduce hands-on time and increases throughput
- **Precise sample handling**
  Sharp sample exchange and a minimum of 50 µl sample per sensor ensures effective sample use
- **High precision flow-control**
  Programming of automated mixing, including concentration gradients of samples, increases reproducibility and reduces preparation time
- **Separately controlled syringe pumps**
  Enable 4 channels to be used independently with different samples and independent measurement sequences
- **Integrated cleaning station**
  Automatic cleaning after measurement
- **Compatible with external accessory chambers**
  For additional capabilities
- **Temperature controlled measurement chamber**
  For thermostat controlled water bath
- **The FlexiFlow feature**
  Enables running different flow rates over different sensors simultaneously



Zoom in on science



Precise sample handling with 1 µl min. volume

Automated mixing of samples

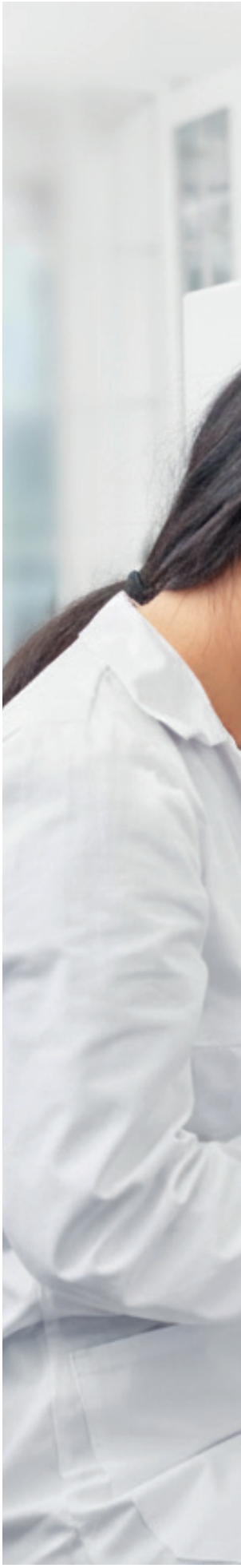
Temperature controlled 8-channel flow module

Super user insights

Our application team at Biolin Scientific is performing daily QCM-D measurements with the QSense systems in our laboratory to create reference data and provide support for our customers. We asked one of our super users Kenneth Olesen why he usually chooses to work with the QSense Pro system.

"QSense Pro is our workhorse in the lab, with excellent sample control to generate reproducible data, day and night. I use pre-defined scripts and let the instrument take care of all sample mixing and introduction, this will keep start-up time at a minimum and provide for excellent instrument throughput. That's productivity!"

Kenneth Olesen
Manager Application Development
& Senior Staff Scientist
Biolin Scientific



Enjoy World-leading Technology

The first step to trustworthy results is to make sure your data reflects the surface interactions under study, and not uncontrolled interference from external factors. The excellent measurement stability and low drift of QSense Pro are key to protecting your data from artifacts, whether you perform shorter or longer measurements. Superior temperature stability, and well-designed and robust electronics ensure that the measured QCM-D response reflects actual changes in the system under study rather than uncontrolled interference.

Next, make sure you choose the technology with the best ability to catch the processes you want to study. The unique QSense Decay Technology is the fastest and most accurate way to measure frequency and Dissipation. Continuous optimization of the data acquisition continues to translate theoretical performance parameters into actual data quality in real measurement situations, making it possible to quantify even the smallest and fastest changes in mass or viscoelastic properties.

QSense key features

- **Robust design**
  Protects the measurements from external shock or vibrations.
- **Superior temperature and measurement stability**
  Safeguards against artifacts.
- **Measurement of 7 harmonics**
  Provides maximal information and allows for quantification of soft layers through full viscoelastic modelling.
- **Minimal noise**
  Distinguishes small changes in mass and viscoelastic properties from noise.
- **QSense Decay Technology**
  Optimized time resolution and data quality to catch the smallest and fastest events and processes, in rigid as well as in soft films.
- **5 Speed-to-Noise Acquisition modes**
  Select the acquisition mode suitable for the process you want to measure.
- **QSense Smart Tuning**
  Continuously fine-tunes the sampling to optimize the data quality in each measurement situation.
- **Flow module with homogenous flow profile**
  Ensures even sample exposure, good thermal stability and lowers risk of trapping air bubbles.

QSense Decay Technology

With the unique decay-based QCM-D technology, QSense instruments are the only instruments on the market offering high accuracy in *f* and *D* changes in combination with speed. In brief, the sensor is excited to resonance, and the decay curve is analyzed under non-voltage conditions as the sensor oscillation is damped. Each sensor excitation results in independent and true values of *f* and *D*, and can be repeated up to 300 times per second. This can be related to QCM-D instruments based on e.g., impedance analysis, which requires either several datapoints to calculate each *f* and *D* value or uses locked stimulation and derived *f* and *D* values at cost of catching large frequency shifts.

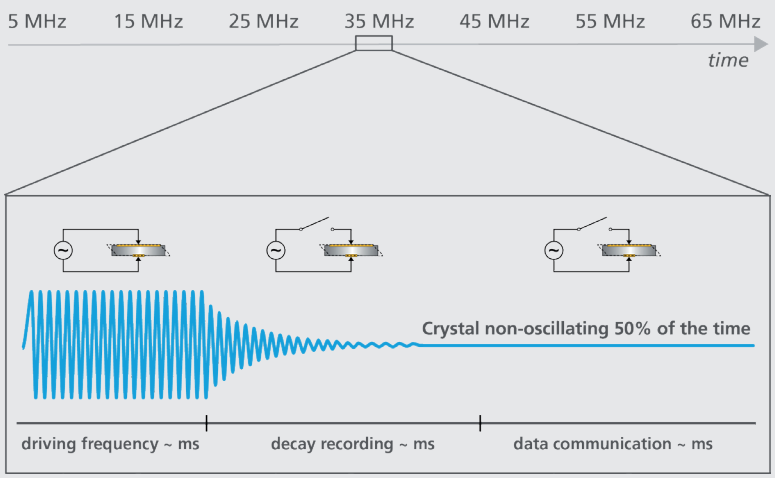


Figure 1 QSense QCM-D sampling

In detail

- Excellent measurement accuracy and stability are achieved through non-voltage readout of *f* and *D*, free from disturbances from parallel impedances.
- Fast sampling with up to 300 *f* and *D* values per second, allows for rapid kinetics experiments.
- Uninterrupted tracking of not only rapid and slow changes, but also small and large shifts in *f* and *D* for all harmonics. The full range of events, from sub-monolayer uptake at the surface to medium exchange from air to liquid, is automatically captured, without compromising the time resolution.
- Measurement of multiple harmonics enables quantification of changes in soft layers and in viscoelastic properties. Changes in layer thickness can easily be distinguished from changes in viscoelastic properties.

QSense Smart Tuning

QSense Smart Tuning tracks your signal to always give you the best possible noise level and sample rate no matter whether you are building thick and soft layers, or thin and rigid films. The Smart Tuning algorithm analyzes the output quality of each *f* and *D* readout and fine-tunes the settings for the next decay-curve acquisition.

Why use 5 MHz Sensors?

Sensitivity, sensing depth, and the ability to perform viscoelastic modeling are optimized by using 5 MHz sensors.

- The theoretical mass sensitivity increases with the fundamental, but so does the noise. This means that a high fundamental frequency does not directly correlate with a better mass detection limit, more important are signal-to-noise ratio and long-term stability.
- The sensing depth decreases with the resonance frequency. The lower the resonance frequency, the thicker the layer that can be sensed.
- To perform full viscoelastic modeling, information on frequency and dissipation from multiple harmonics is needed. The fundamental affects how high the frequency of the harmonics will be, and as the impact of noise will be more noticeable as the frequency increases, a low fundamental is desirable.

Optimal Real-life Performance

Applying a higher sample rate inevitably leads to higher noise and thus a compromised limit of detection (LOD). What aspect to prioritize depends on the studied surface interaction process. High time resolution may not be critical if very slow changes are studied, and a high measurement sensitivity may not be important if large changes are to be measured. With the 5 Speed-to-Noise modes you can select the right setting to maximize real-life performance for your measurement.

The below figure and table describe the real-measurement performance of QSense Pro for each acquisition mode using all channels. The sample interval can be significantly shortened (~4 times) by using a single channel.

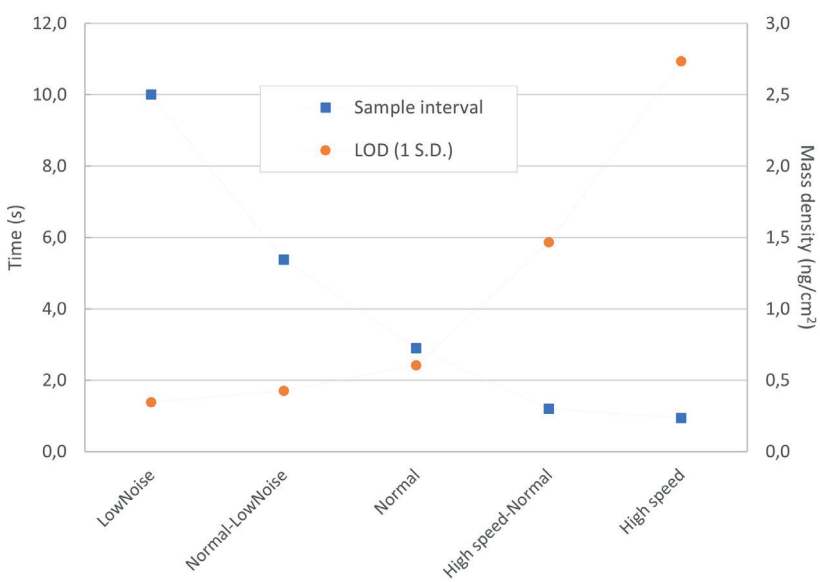


Figure 2 Speed and limit of detection (LOD) per acquisition mode. Limit of detection is set to 1 S.D. of the baseline noise.

Mode	Time to capture 7 harmonics (s)	f/n-noise (Hz)	mass-noise (ng/cm²)	D-noise ($\cdot 10^{-6}$)
LowNoise	10.00	0.02	0.35	0.01
Normal-LowNoise	5.38	0.02	0.43	0.01
Normal	2.89	0.03	0.60	0.01
High speed-Normal	1.20	0.05	1.47	0.02
High speed	0.94	0.11	2.73	0.04

Figure 3 Performance characteristics

Measurements were performed with QSX 303 SiO_2 sensors at 20°C temperature, and in deionized water at a flow of 15 µL/min. Each measurement mode was measured for approximately 5 minutes.

Explore More

Widen your possibilities

You can extend your experimental scope by adding an accessory chamber to your QSense Pro*. It will give you the possibility to combine QCM-D measurements with other techniques, apply alternative experimental set-ups or extend measurement conditions. Have a look at our range of available modules and chambers to find the best choice for you.

QSense Window module
Giving optical access to the sensor surface, this module enables simultaneous QCM-D and microscopy measurements on the same surface. You can also perform light or irradiation sensitive measurements.

QSense Electrochemistry module
Want to conduct simultaneous QCM-D and electrochemistry measurements on the same surface? This module supports a wide range of electrochemical methods, for instance cyclic voltammetry and electrochemcal impedance measurements to explore polymer behavior, electrostatic interactions, corrosion, etc.

QSense Window Electrochemistry module
The module enables simultaneous QCM-D and electrochemistry measurements with optical access to the sensor surface. This module is typically used in applications like photovoltaics.

QSense Ellipsometry module
QSense Ellipsometry module lets you perform simultaneous QCM-D and ellipsometric measurements on the same sensor surface. Combining both techniques can add insight into the solvent content, which is valuable in applications spanning from polymer studies to vesicles.

QSense Open module
The Open module is tubeless with the lowest possible sample volume requirement. You can directly pipette a minimal amount of liquid to cover the sensor. This module will provide for evaporation studies, external triggered reactions such as photo induced reaction and chemically triggered reactions.

* The accessory chambers allows for 1-channel measurement where one of the syringe pumps is utilized to drive liquid through the external flow module while samples are handled manually.

Our modules

QSense Window module

QSense Electrochemistry module

QSense Window Electrochemistry module

QSense Ellipsometry module

QSense Open module

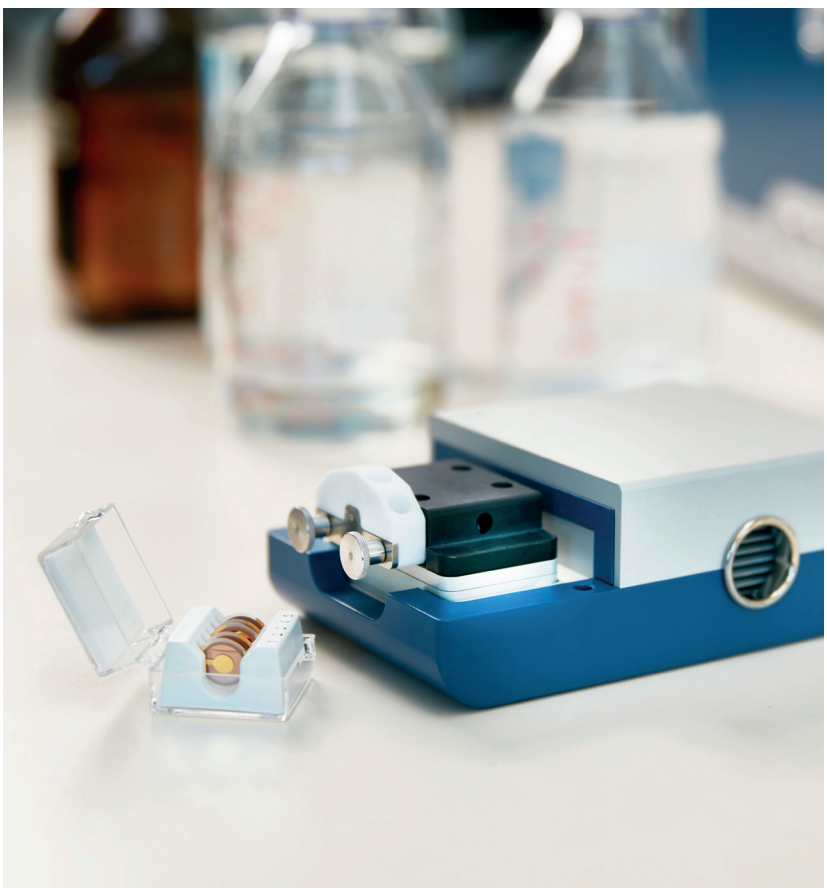
QSense High Temperature chamber and module
The QSense High Temperature chamber and module allow for additional one channel measurements in the 4-150°C temperature range, in both flow and stagnant conditions.

QSense High Pressure chamber and module
The QSense High Pressure chamber and module allow you to run experiments at elevated pressures and temperatures. The system is capable of running at pressures up to 200 bar and temperatures up to 150° C. We also offer customization to suit your specific research needs.

QSense PTFE Flow module
Flow module with the upper part made of PTFE. Suitable for measurements sensitive to titanium which is the interior material of the standard flow module.

QSense Humidity module
Designed to enable measurements of vapor uptake and release from thin films coated on the sensor.

QSense ALD holder (Atomic Layer Deposition)
For measurements in vacuum or gas phase.



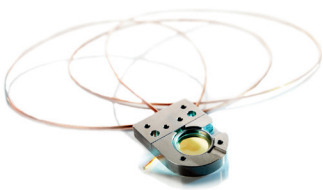
QSense accessory chamber with the Ellipsometry module

QSense High Temperature chamber and module

QSense High Pressure chamber and module

QSense PTFE Flow module

QSense Humidity module



QSense ALD holder

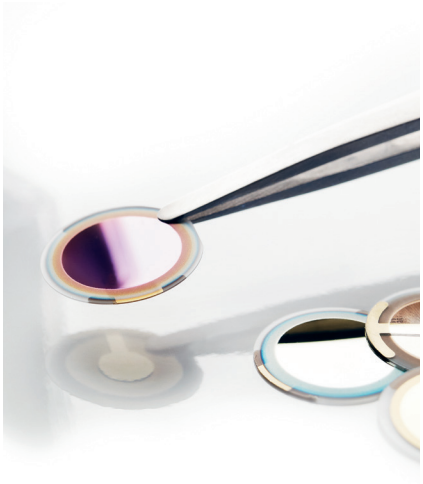
Choose between a variety of sensors

The choice of sensor coating is crucial for your experiment. To match your needs, we offer over 50 standard sensor coatings - from various metals, oxides and carbides to polymers, functionalized coatings and standardized soils. Which sensor material and coating is best suited for your research? Visit biolinscientific.com to see your options.

Our sensors are developed and produced to provide you with stable, reliable and reproducible data. Full performance is ensured through extensive quality controls and guaranteed for one-time use according to the recommendations.

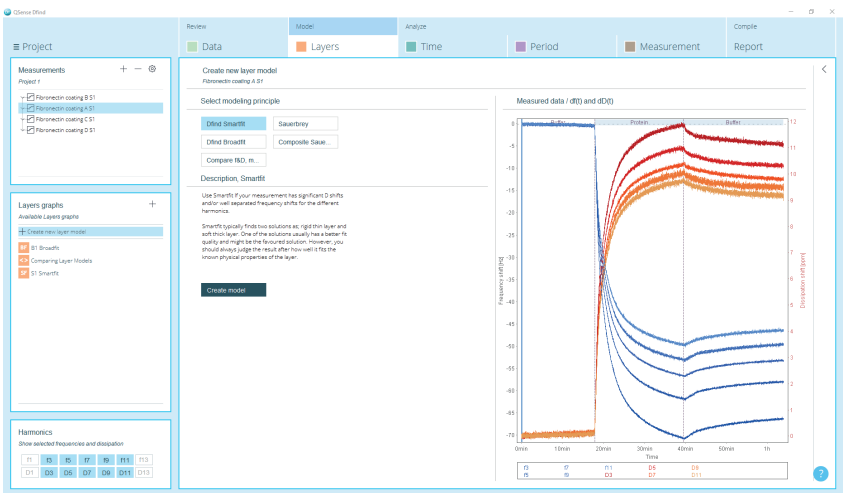
Custom-made for you

We have the widest range of quality sensors on the market, and also the capability to customize both materials and coatings based on your requirements.



Discover an intuitive analysis software

Reveal the full potential of your data with Dfind - the reliable and easy-to-use analysis software from QSense. It helps you to quickly and simply extract the information you are looking for, such as mass, thickness, viscoelastic properties and adsorption rates.



Analysis software QSense Dfind

Dfind features

- **Automated full viscoelastic modelling**
  Up to 5 fitted parameters - time resolved mass, thickness, viscosity, shear modulus and the frequency dependence of the viscosity and shear modulus.
- **Dynamic output data**
  Including kinetics, slope, rise time and more.
- **3 modelling methods and traffic lights**
  Indicating the quality of each model fit.
- **Automatic data plotting and reporting tool**
- **More than 10 pre-defined methods for data extraction**
- **Batch mode for simultaneous analysis**
  Process more than 100 datafiles at the same time and easily add new data files step-by-step.
- **Template tool**
  Supporting reuse and sharing of data analysis templates with other users.

The QSense Range

QSense Omni

- The latest and sharpest QCM-D technology
- The most trustworthy and reproducible data
- Smooth and automated procedures with maintained

QSense Analyzer

- Be both flexible and fast
- Test and compare several samples at the same time
- Run experiments in special conditions

Not sure which instrument to choose?

Our tool InstruMentor will guide you along the way to your new instrument. Just answer a few questions and the instrument selector will provide you with the top choices based on your specific needs.

QSense Pro

- Be fast and productive without losing quality
- Test and compare several samples at the same time
- Get highly reproducible results

QSense Explorer

- Get the flexibility to change between experimental setups
- Combine QSense with complementary techniques
- Run experiments in special conditions

QSense Initiator

- Get started with QCM-D
- Be confident to get high quality data
- Get qualitative data but not quantify your films

Specifications

Measurement range and capacity	
Measurement channels	8
Working temperature	4 to 70 °C, 4 to 150 °C using accessory chamber (QSense High Temperature chamber)
Sensors (frequency range)	5 MHz (1-72)
Number of measured harmonics	7, allows for full viscoelastic modeling

Sample and fluidics	
Minimum sample volume, stagnant mode	~ 15 µl ~ 1 µl minimum dispense volume
Minimum sample volume, flow mode	~ 50 µl
Flow rates	Typical flow rate 20 µl/min. Flow speed range 1-40 µl/min (4 sensors), 1-100 µl/min (1 sensor).

Performance characteristics	
Maximum time resolution	100 datapoints per second (each datapoint represents an *f* and *D* value)
Sensitivity/limit of detection and noise	Refer to performance in different modes on page 10
Long-term stability[a]	Frequency: < 1 Hz/h Dissipation: < $0.15 \cdot 10^{-6}$ Temperature: < 0.02˚C/h

Software	QSoft Acquisition Software	Dfind Analysis Software
Data output	Time resolved Frequency and Dissipation for 7 harmonics	Thickness (or mass), viscosity, shear modulus and the frequency dependence of the viscosity and shear modulus. Kinetics, slope, rise time and more
Computer requirements	USB 2.0	PC with 64-bit > 1366×768 px screen resolution, > 4 GB RAM
Operating system	Windows 10 or later (earlier Windows versions may not fully work and support cannot be guaranteed)	
Import/export	Excel, BMP, JPG, WMF, GIF, PCX, PNG, TXT	CSV files. Decimal separator, full stop or comma

Electrical data	
Power supply and frequency	100-120 / 220-240 V AC / 50/60 Hz The power supply should be properly grounded

Dimensions and weight	Height (cm)	Width (cm)	Depth (cm)	Weight (kg)
	70	67	57	83

[a] The temperature stability depends on variations in how the ambient affects the warming or cooling of the chamber. The specified temperature stability may not be reached if the room temperature changes more than ± 1° C, if there is a draft or a heat source nearby. All specifications are subject to change without notice.

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About us

At Biolin Scientific we are committed to empower professionals in Surface and Interface science and engineering to reach outstanding results faster and easier. Our instruments and sensors are tailored for advanced analysis of thin film properties and surface and interface phenomena at the nanoscale. Trusted by top universities and industrial labs worldwide, our premium solutions help solve complex challenges and drive progress in scientific research and product development.

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