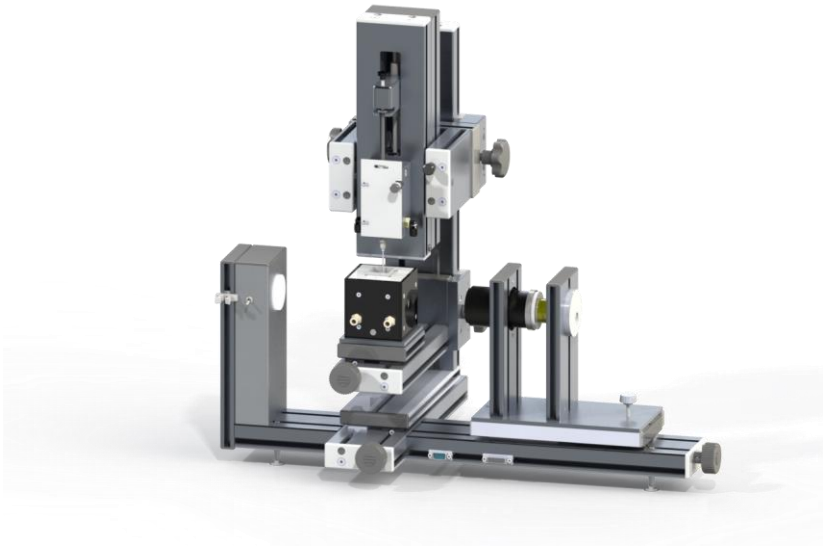
TRACKER™

Interfacial Rheology



Interfacial Rheology

Interfacial Dilatational rheology represents a powerful tool to investigate equilibrium and dynamic properties of simple and more complex interfacial layers containing surfactants, proteins, polymers or micro–nano sized particles.

Interfacial rheology allows a better understanding of the properties of surfactants, proteins, polymers or micro–nano sized particles at the interface. Moreover, it enables the **study of adsorption-desorption** phenomena as well as interactions that can take place at the interface. That can reveal crucial information on interfacial dynamics and the contribution of the structure to formulation properties.

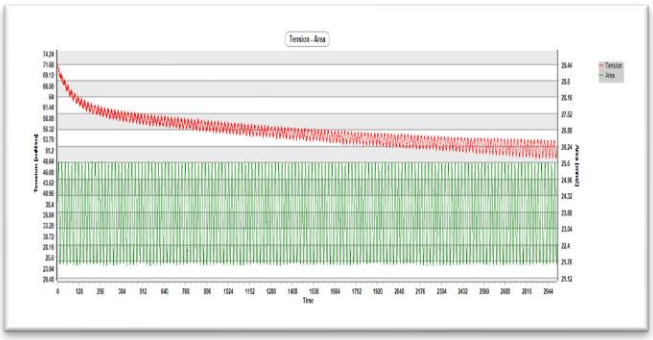
The calculation of the viscoelastic modulus gives a better understanding of how elasticity and viscosity properties of interfaces can be modified and correlated with the stability of foams and emulsions.

Interfacial Rheology by TRACKER™

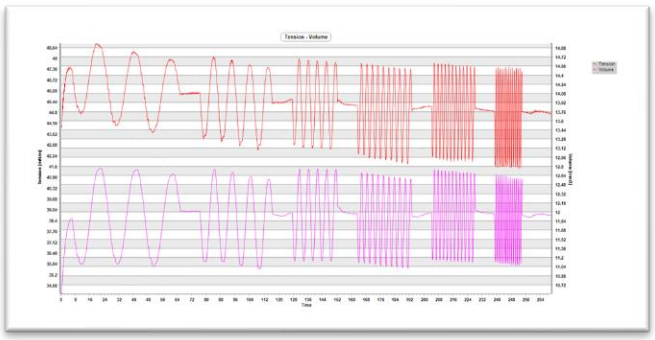
TRACKER™ software enables to precisely control the drop/bubble volume or area and to perform at the same time a sinusoidal variation whose frequency and amplitude is determined by the user. From the basic single-frequency oscillation to complex scenarios including several oscillation steps, all measurement parameters can be set or changed independently, even during measurement:

- Oscillating frequency: from 0.001Hz to 2Hz and up to 10Hz with Piezoelectric module
- Drop volume variation: from +/- 0.1 µl to +/- 100 µl and up to +/- 4 µl with Piezoelectric module
- Volume variation Speed min : 0.01 µl/s
- Volume variation Speed max : 20 µl/s
- Time: drop or bubble area remains constant during oscillations for several hours including at a gas-liquid interface.

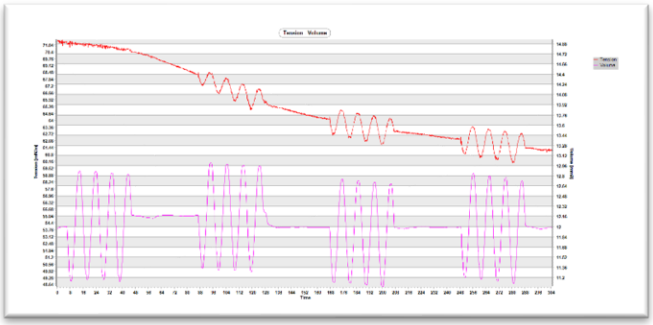
Interfacial rheology measurement examples with TRACKER™



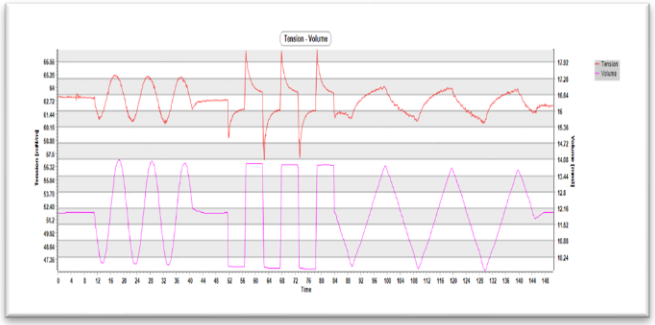
Ex 1: Area regulation during adsorption kinetics



Ex 2: Volume regulation with frequency sweep



Ex 3: Volume regulation with and without oscillation periods



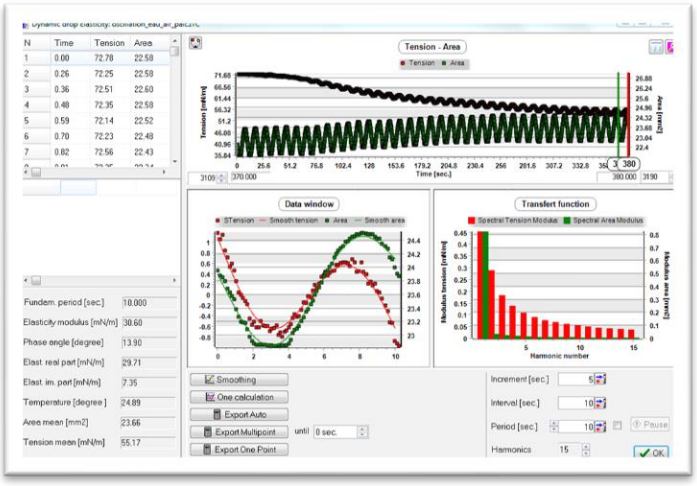
Ex 4: Volume regulation with amplitude sweep

VISCOLEASTIC MODULUS

Viscoelasticity calculation can be performed during the measurement.

$$E = d\gamma/(dA/A)$$

Raw data are recorded, either as drop images or measurements. They can be opened later for re-analyzing and/or reevaluation.



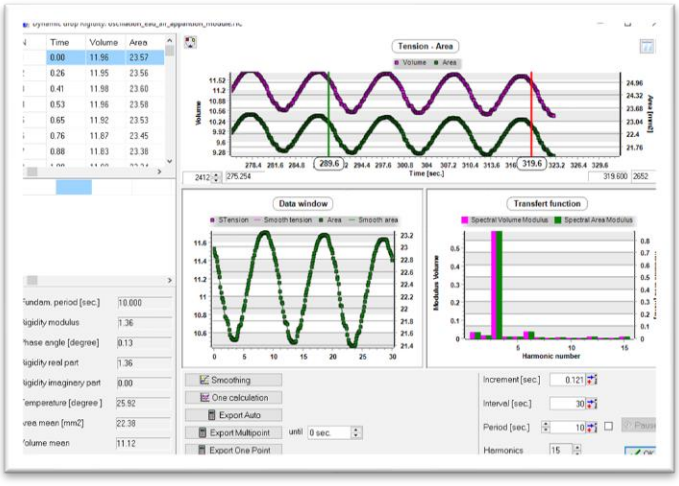
Example of Viscoelastic modulus Calculation

RIGIDITY MODULUS

The calculation of the modulus of rigidity can be performed during the measurement.

$$Rigidity = (dV/V) / (dA/A)$$

It enables to highlight the appearance of membrane on surfaces.



Example of Rigidity modulus Calculation

Compression & dilatation Interfacial rheology

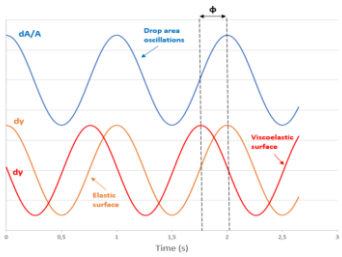
Interface deformation consists of a variation in the interfacial area A (compression & dilatation).

The response of the interface to such deformation is manifested by a variation in surface tension γ.
A viscoelastic modulus can be defined as the increase in surface tension as a function of surface deformation.

$$E = d\gamma/(dA/A) = d\gamma/d\ln(A)$$

The viscoelastic modulus in compression/dilatation is therefore the coefficient of proportionality between a deformation (dA/A) and a surface stress (in N/m), surface tension.

If the deformation varies over time, the ratio between stress and deformation speed with the corresponding surface viscosities can be calculated. If a surface is sinusoidally dilated and compressed at a frequency ω and an amplitude ΔA, and for a viscoelastic surface, a phase shift θ may occur between the change in strain ($\Delta A/A_0$) and the surface tension.



The viscoelastic modulus E becomes a complex number, with a real part E', representing the stored and recoverable energy, and an imaginary part E'', corresponding to the mechanisms that dissipate mechanical energy.

$$E = |E|\cos(\theta) + i|E|\sin(\theta)$$

$$E' = |E|\cos(\theta)$$

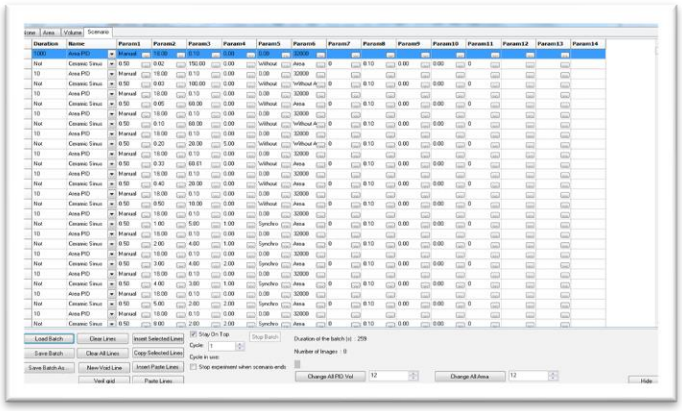
$$E'' = |E|\sin(\theta)$$

BATCH: SCENARIO MANAGEMENT

Batch function enables to write a scenario with an unlimited number of steps or actions to be carried out on the droplet/bubble during the measurement.

All measurement parameters can be set or changed independently, even during measurement:

- Area/volume drop regulation
- Oscillating frequency
- Oscillation amplitude
- periods
- Time

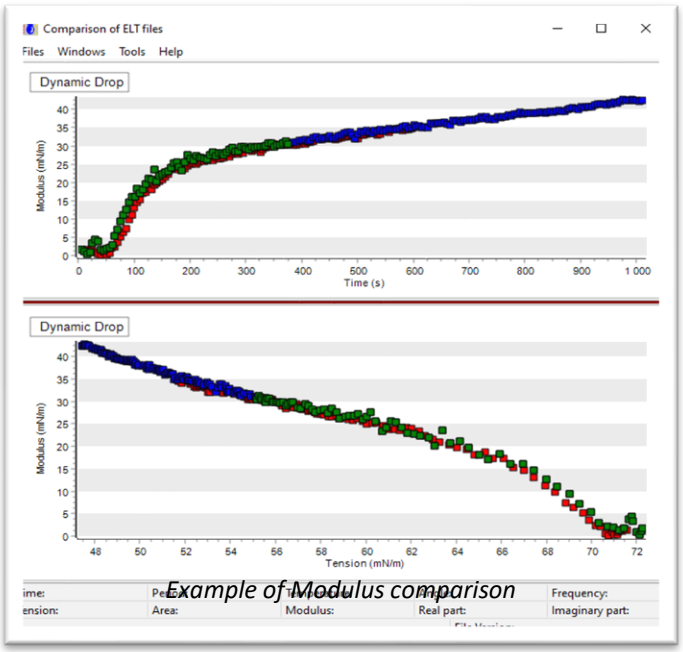


Example of Batch settings

DATA COMPARISON

Raw data are recorded, either as drop images or measurements. They can be opened and compared in the software directly. Drop images and measurement data can also be opened later for re-analyzing.

Viscoelastic and Rigidity Modulus Results can also be compared directly in the software without prior data export.



Example of Modulus comparison

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