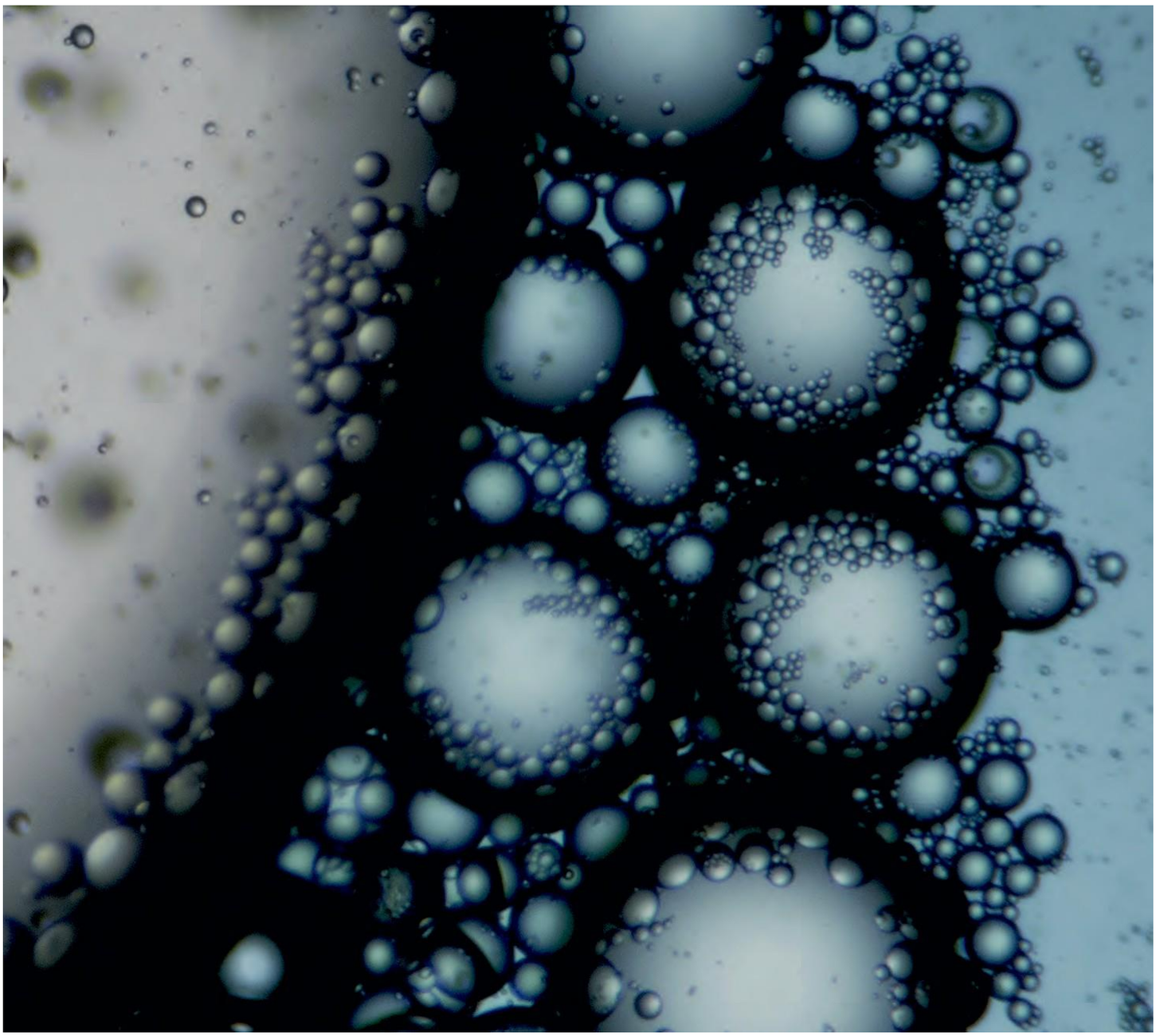
Attension Theta High Pressure

Optimize Oil Recovery



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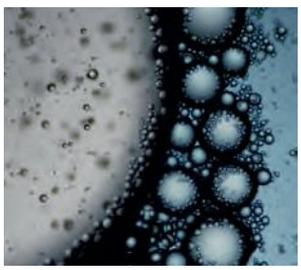
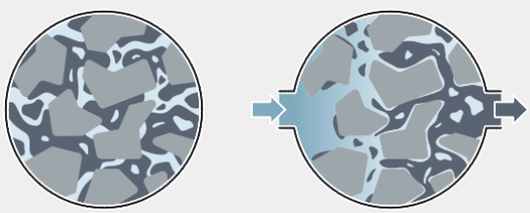
Increase Oil Field Yield through Interfacial Chemistry

In oil recovery at least 50% of the original oil is left behind in the reservoir after primary and secondary oil recovery. Expensive injections of polymers, surfactants or different gases are commonly used to displace and dissolve some of the remaining oil. This process, called tertiary or enhanced oil recovery EOR, can lead to an additional 8-16% uptake of original oil in place.[1] Many of the effects of EOR can be explained with interfacial chemistry. However more research is needed to better understand and optimize the methods to increase yield and reduce costs.



Wettability and Interfacial Tension

Rock wettability and interfacial tension have been identified as two key parameters for oil recovery effectiveness. Rock wettability can be optimized by introducing another medium or modifying the environment in the oil well to displace more oil from the rock. The interfacial tension between the oil and the surrounding gas or liquid should be lowered to aid the mobility of the oil.



Optimization of oil displacement and mobility

Left:

Oil-wet state where oil is trapped by rocks in the reservoir.

Right:

Rock wettability has been modified towards water-wet state which releases more oil. Additionally the interfacial tension has been lowered which aids the mobility of the oil in the well.

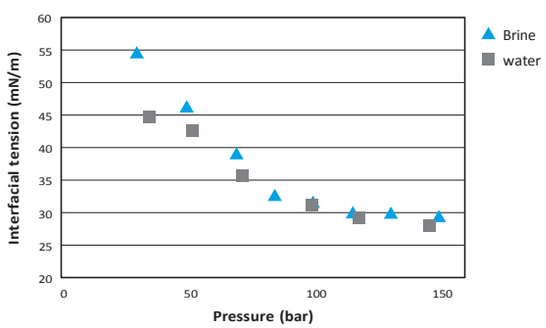
Understanding the Mechanisms

By measuring wettability and interfacial tension you can get information on how to optimize:

- EOR processes by measuring interfacial tension between oil, brine, water, surfactant solution, CO_2 or other EOR fluids
- Rock material wettability to increase oil reservoir yield
- Efficiency of CO_2 in flooding EOR by measuring the minimum miscibility pressure (MMP) of CO_2
- CO_2 storage and wettability of rock material with CO_2
- EOR oil displacement with supercritical fluids (SCF)
- Drilling fluid composition and effectiveness

Extreme Conditions

Conditions in the oil reservoir are harsh with high temperatures and high pressures. These parameters have a strong effect on wettability and interfacial tension which makes it important to measure under relevant conditions. The high pressure and temperature in combination with corrosive liquids like brine and fouling fluids like oil also put very high demands on the measurement equipment.



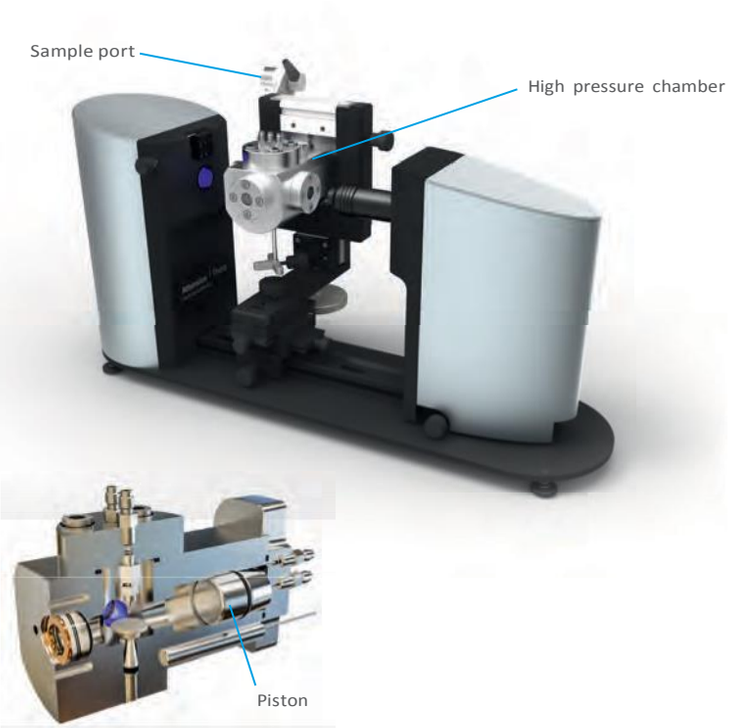
Influence of pressure on interfacial tension

Measurement example of interfacial tensions between brine/CO2 (triangles) and water/CO2 (squares) as a function of pressure.

[1] Li, X., Boek, E., Maitland, G.C. and Trusler, J.P.M., Journal of Chemical Engineering & Data, 57 (2012) 1078.

Attension Theta High Pressure

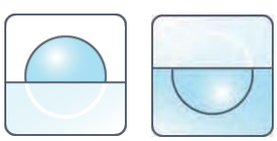
The Attension® Theta High Pressure is a precise and easy to use tensiometer that measures wettability and interfacial tension at high pressures and high temperatures. It is designed with the harsh reservoir conditions in mind to facilitate the use and yet offer wide measurement possibilities.



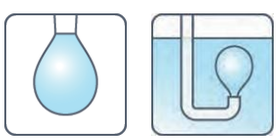
Cross section of the high pressure chamber with piston

Measurement Principle and Methods

The Attension Theta High Pressure is an optical tensiometer which means that the instrument records the drop with a camera and automatically analyzes the drop shape. The drop shape is then converted into surface tension, interfacial tension or contact angle information by advanced drop profile fitting.



Sessile drop and Captive bubble
Measure wettability of a solid surface by a liquid, through contact angle measurements and surface free energy calculation.



Pendant drop and Reverse pendant drop
Measure interfacial tension between two liquids, or surface tension of a liquid in gas environment.

Easy to Use

Sample introduction and system cleaning made simple

The smart sample port enables direct introduction of sample with a syringe and direct cleaning of the same sample line without passing through a pump.

Minimal corrosion risk

The corrosive liquid is introduced directly into the high resistant chamber to minimize any corrosion risk.

Automated pressure control

Measurement pressure is automatically reached and kept when using automatic pumps.

Facilitates Measurements

Automatic droplet creation

With automatic pumps, droplet creation can be automated to reduce hands-on time.

Surfactant studies at constant concentration

The unique chamber design with a moving piston enables pressure change without adding more fluid.

Intuitive software with high functionality

OneAttension software features include live analysis and automatic measurements.

Broader Surface Science Possibilities

Liquid and gas studies

The automatic syringe pump easily compresses either gas or liquid.

Wide experimental conditions

Temperature control options for both elevated temperatures and sub-room temperatures.

Versatility in Measurements

Surface tension, interfacial tension, contact angle and surface free energy in one set.

Ver. 2019-03

	HPC1 Manual measurements of liquids	HPC1-Auto Automated measurements of liquids	HPC2-Auto Automated measurements of liquids and gases
Included high pressure pumps	2 manual pumps	2 automated HPLC pumps	1 automated syringe pump for bulk phase 1 automated HPLC pump for droplet phase
Temperature range	ambient...200C	ambient...200C	1...200C
Measurement types	Surface tension, interfacial tension, contact angle, surface free energy		
Maximum pressure	400 bar		
Chamber volume	85 ml without piston, 40-62 ml with piston		
Pressure control options	Pressure increase by integrated piston Pressure increase by adding more liquid/gas with pump		
Sample introduction and fl shing	Through integrated 6-port valve		
Max solid sample size	20 mm x 20 mm x 8 mm (xyz)		
Maximum camera resolution	1984 x 1264 px		
Maximum measuring speed	3009 fps		
All-inclusive software	OneAttension		
Dimensions	74 cm x 25 cm x 61 cm (L x W x H) for Theta and chamber		
Weight	16 kg (Theta and chamber)		
Power supply **Frequency**	100 - 240 V AC 50 - 60 Hz		
Recommended system requirements	2 GHz processor, 2 GB RAM, 120 GB hard disk drive [1], 1024x768 resolution, 1 USB2 or USB3 port, 1 USB3 port, 1 additional USB2 or USB3 port if Peltier used, Windows7/8/10 (32 or 64 bit)		

[1] SSD hard disk (min. 500 MB/s) needed for high speed recording with high resolution

About Us

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.

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