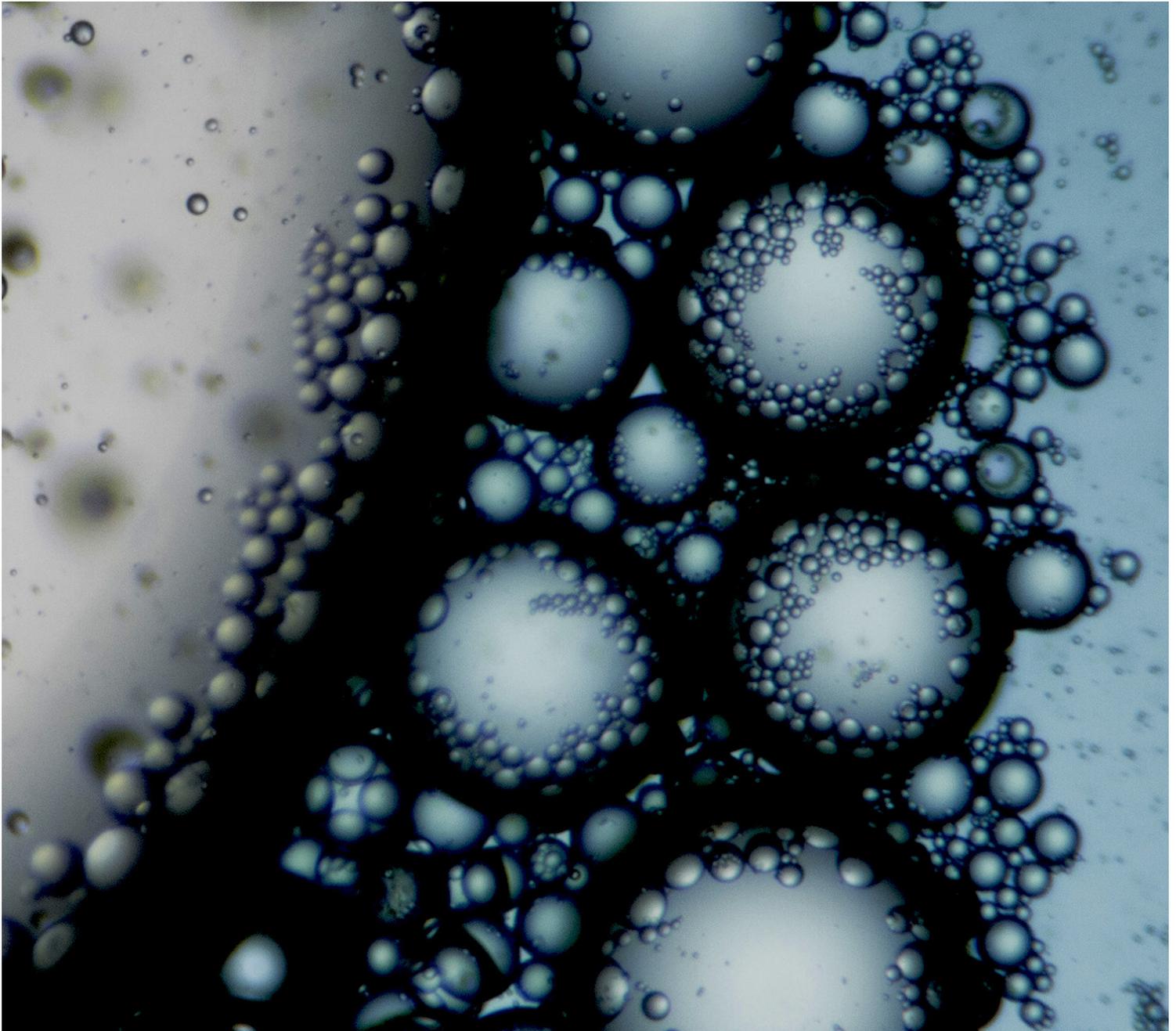


# Attension Theta High Pressure

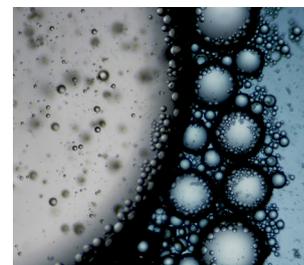
Oil recovery optimization

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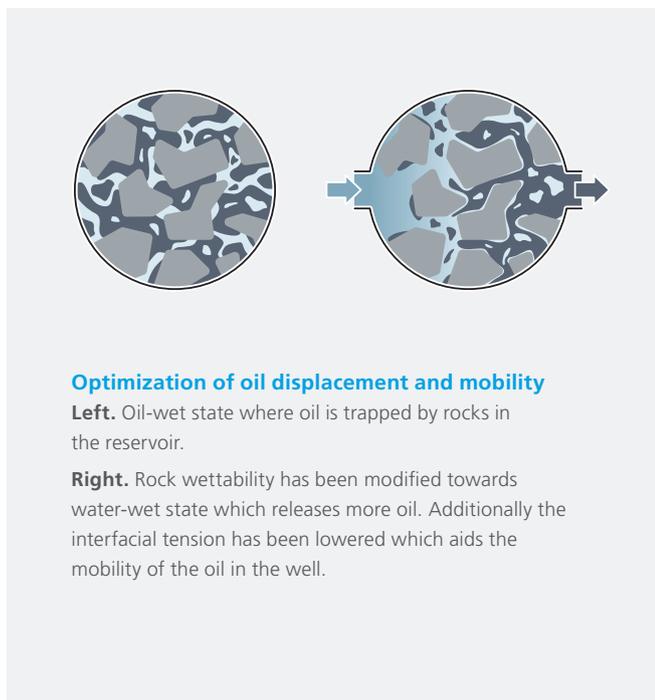
# Increase Oil Field Yield through Interfacial Chemistry

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.<sup>1</sup> 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.



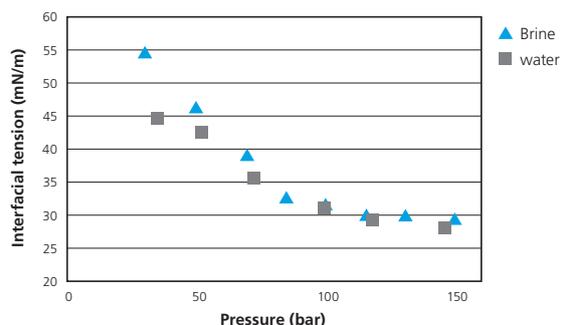
## Understanding the mechanisms

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<sub>2</sub> or other EOR fluids
- Rock material wettability to increase oil reservoir yield
- Efficiency of CO<sub>2</sub> in flooding EOR by measuring the minimum miscibility pressure (MMP) of CO<sub>2</sub>
- CO<sub>2</sub> storage and wettability of rock material with CO<sub>2</sub>
- 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.



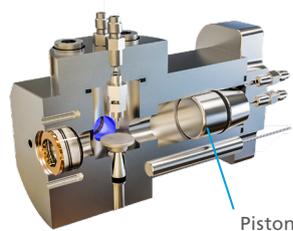
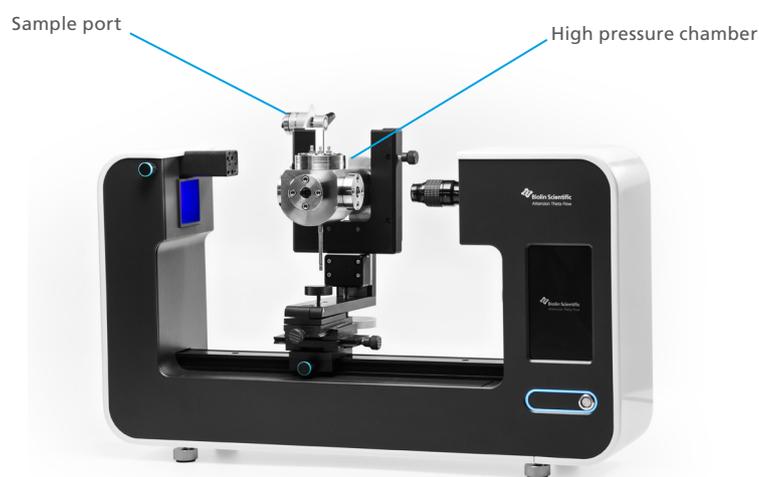
### Influence of pressure on interfacial tension

Measurement example of interfacial tensions between brine/CO<sub>2</sub> (triangles) and water/CO<sub>2</sub> (squares) as a function of pressure.

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

# 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.



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



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, autofocus and optimized image quality with top resolution.

## 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.

# Specification

	<b>HPC1</b> Manual measurements of liquids	<b>HPC1-Auto</b> Automated measurements of liquids	<b>HPC2-Auto</b> Automated measurements of liquids and gases
<b>Base unit</b>	Theta Flex	Theta Flow	Theta Flow
<b>Included high pressure pumps</b>	2 manual pumps	2 automated HPLC pumps	1 automated syringe pump for bulk phase 1 automated HPLC pump for droplet phase
<b>Temperature range</b>	ambient...200C	ambient...200C	1...200C
<b>Measurement types</b>	Surface tension, interfacial tension, contact angle, surface free energy		
<b>Maximum pressure</b>	400 bar		
<b>Chamber volume</b>	85 ml without piston, 40-62 ml with piston		
<b>Pressure control options</b>	Pressure increase by integrated piston Pressure increase by adding more liquid/gas with pump		
<b>Sample introduction and flushing</b>	Through integrated 6-port valve		
<b>Max solid sample size</b>	20 mm x 20 mm x 8 mm (xyz)		
<b>Dimensions</b>	74 cm x 25 cm x 61 cm (L x W x H) for Theta and chamber		
<b>Weight</b>	35-38 kg (Theta and chamber)		

## About us

We are Biolin Scientific. A worldwide company making state of the art instruments and smart solutions for scientists. Knowledge is our greatest resource and an essential part of everything we do. In collaboration with leading universities and industries, we solve challenges to simplify the everyday life in the lab. Our customers are the experts in surface science, and we have the tools for them to progress.

### Biolin Scientific AB

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