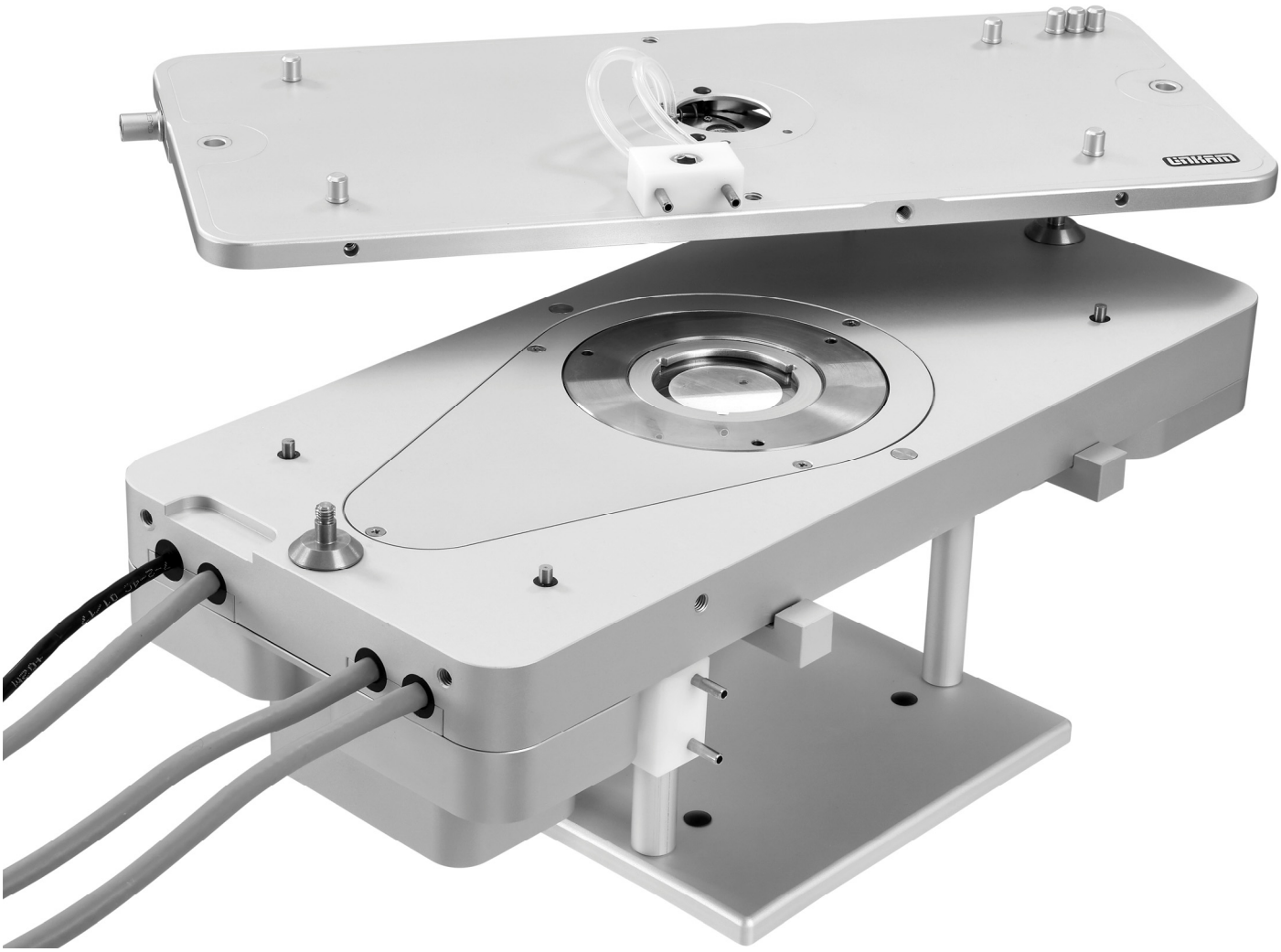
# CSS450

## Optical Shearing System



**Heating and Freezing**
Precision temperature control from –50°C up to 450°C

**Real Time Imaging**
Better understand your sample by correlating visual changes and rheological data

**Choice of Shear Modes**
Choose between oscillatory, steady and step rotational modes

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# Introducing the CSS450

Linkam's Optical Shearing System (CSS450) allows the structural dynamics of complex fluids to be observed directly via a standard optical microscope under precisely controlled temperature and various shear modes.

The CSS450 enables the study of the microstructural evolution of complex fluids in great detail for many physical processes including the coarsening of binary fluids during their phase separations, flow-induced mixing and de-mixing of polymer blends, defects dynamics of liquid crystals, and the aggregation of red blood cells and their deformation in flows. This enables correlation of micro-structural dynamics with rheological data for gaining insight into the rheology of complex fluids.

To accommodate various textures or particle sizes in different samples the gap between the two plates can be precisely set from 5 to 2500um and the speed of this change in gap setting can also be varied. The CSS450 can be modified to be used with X-ray techniques and also with an LNP96-D liquid nitrogen cooling pump to further extend the temperature range to -50°C, which has enabled work on the effects of shear on ice crystals.

Two systems are available:

- **CSS450 Optical Rheology System** which comprises of a CSS450 stage, T96-S controller, LINK software and stage clamps.
- **Low Temperature CSS450 Optical Rheology System** which additionally includes an LNP96-D and Dewar flask.

## Features

### Wide Temperature Range
The temperature range spans from –50°C (with the addition of an optional LNP96-D) to 450°C for a versatile range of experiments.

### Shear Modes
Choice of shear modes including oscillatory, steady and step, to study the microstructure evolution of complex fluids.

### Variable Gap Settings
The gap between the top and bottom plate can be varied between 5µm - 2500µm for different sample sizes and textures.

### Heated Stage Body and Lid
The stage body and stage lid are fitted independently with heaters allowing uniform temperature between body and lid.

### X-ray Techniques
The CSS450 has been used successfully with SAXS/ WAX or synchrotron equipment to characterise samples with shearing stress. Linkam can supply Kapton or Mica windows in place of the standard quartz.

### Custom Options
Please contact us with details of your requirements.

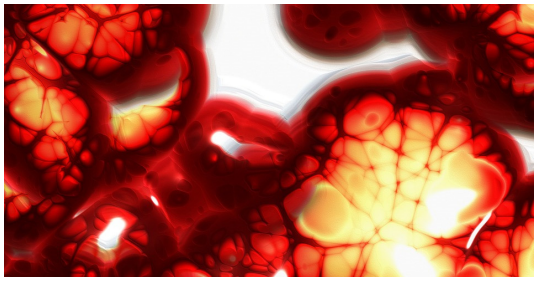
# Application Examples

The CSS450 stage was developed in collaboration with Cambridge University. It is a unique instrument enabling high resolution imaging of samples under various shearing conditions and temperatures, and can be used for a variety of applications including:

### Life Sciences

The CSS450 is used by researchers to aid pioneering research of biological materials, from blood analysis to artificial muscle characterisation. It can also be used to observe and image stress or stretching of biomaterials, as well as flow and mixing mechanics.

Tissue Stress | Coagulation | Cell Stretching



### Food Research

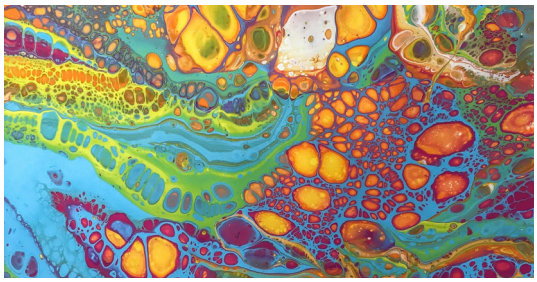
Many well known food and drinks manufacturers and food scientists use the CSS450 to simulate and image ingredient mixing behaviour, emulsion formation, and temperature stability of frozen foods.

Mixing | Mastication | Thermal Analysis

### Plastics and Polymers

Within the materials testing field, the CSS450 is ideal for testing emulsions and polymer melts, composite materials and rubbers. It gives insight into shear properties through image analysis.

Self-healing | Nucleation Rate | Elasticity



# Technical Specification

| | |
|---|---|
| **Temperature Range** | -50°C (with the addition of an optional LNP96-D) to 450°C |
| **Heating/Cooling Rates** | 0.01°C to 30°C/min |
| **Temperature Stability** | +/-0.2°C |
| **Gap Setting** | Between 5µm and 2500µm |
| **Objective Lens Working Distance** | 7.4mm |
| **Observation radius** | 7.5mm diameter (viewing area 2.8mm diameter) |
| **Shear Rate** | 0.003 $s^{-1}$ to 7500 $s^{-1}$ |
| **Strain** | 0.1% to 40,000% |
| **Velocity** | 0.001 $s^{-1}$ to 10 $s^{-1}$ |

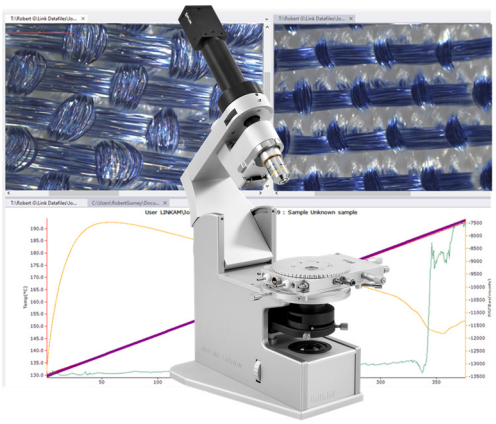
# Discover More...


### Control Options

Take control of your experiment with LINK software, or the stand-alone LinkPad touch screen, alongside the T96 temperature controller.

Both LINK software and LinkPad share a unified user interface that can control and monitor temperature and many other parameters including vacuum, humidity, tensile and shear force (dependent on system). The LinkPad provides an easy-to-use interface to the T96, for total control without a PC. Profiles with up to 100 ramps can be programmed, allowing simulation of complex processes.

LINK software enhances this with data-logging functions and real time graphical feedback. Optional modules to enhance your system include the LINK Imaging Module for synchronised image capture, the LINK Extended Measurements module to measure key image features, the LINK 21CFR11 Module for data regulatory compliance, and LINK TASC providing image-based thermal analysis.



### Imaging Station

The Imaging Station provides a digital imaging platform compatible with Linkam temperature and environmental control systems. Use our high-resolution camera to capture images and videos of your samples while controlling the temperature and environmental conditions.

The Imaging Station has been specially designed with a pivoted mechanism to allow greater access to your Linkam stage, making it quick and easy to access the chamber and change samples. It has a built-in LED light source for transmitted light with further options available for reflected light, polarisation and phase contrast imaging.

The Imaging Station is also compatible with a range of long working distance objective lenses which can be easily switched with the quick-release mechanism.

### MFS — Modular Force Stage

The MFS provides an ideal platform for analysing the tensile properties of materials in relation to temperature and other environmental conditions, including humidity control (when combined with our RH95), or in situ submerged measurements with our liquid cell.

A number of modular options are available, facilitating temperature control from <-195°C up to 350°C, force ranges from 0 up to 600N, humidity control, and grips enabling a wide variety of sample types to be tested.

The MFS can be used for precise mechanical and optical characterisation including modulus analysis, single fibre strength tests, failure mode and fracture analysis, peel adhesion tests, compression and three-point bend testing, and many more with our custom-designed grips.

# Contact Details

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We make scientific instruments that help characterise materials from polymers to biological tissue and metals to composites. Our instruments are used for research by the world's most advanced scientific organisations and companies. Each of our instruments are designed and manufactured in-house by our team of highly experienced electronics, software and mechanical design engineers. We design and develop solutions for sample characterisation by collaborating with the best scientists in the world. Will you be next?

*Linkam products are constantly being improved, hence specifications are subject to change without notice.*
*TASC products are a family of techniques developed by Prof. Mike Reading (Cyversa) and Linkam.*

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