

zhaw



NanoLockin
ADVANCED THERMAL IMAGING

School of Engineering

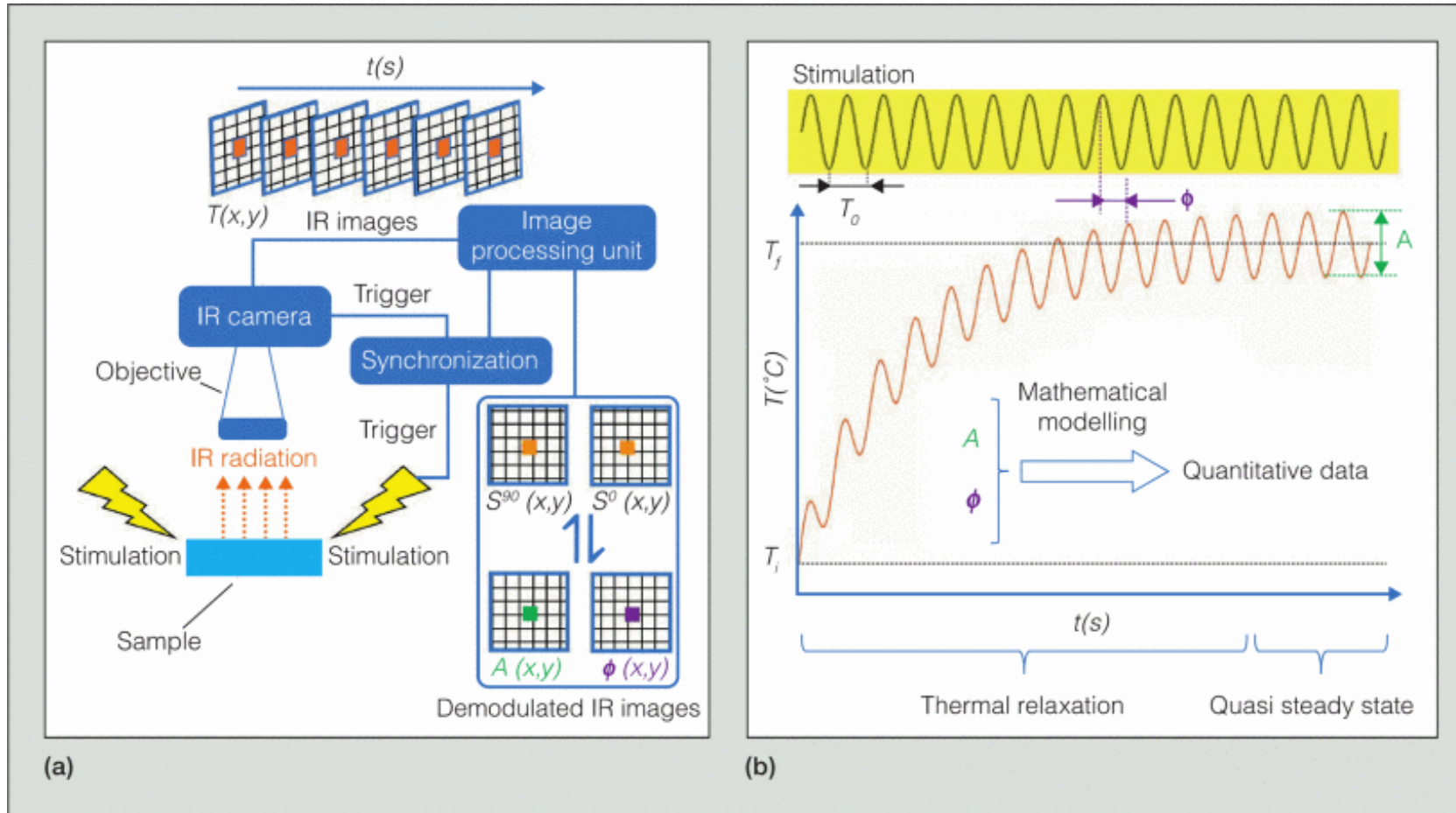
Precision Measurement in Low-Volume and Microfluidic Systems with Lock-in Thermal Imaging

Sensors and Measurements Systems Group | NanoLockin GmbH
Photonics4MedTech Workshop
10th of September 2026 | Mathias Bonmarin

SWISS PHOTONICS

1. What is Lock-in Thermography (LIT)?
2. Flow Analysis with LIT
3. Pipette Volume Measurement with LIT
4. Questions and discussion

What is LIT?



Advantages

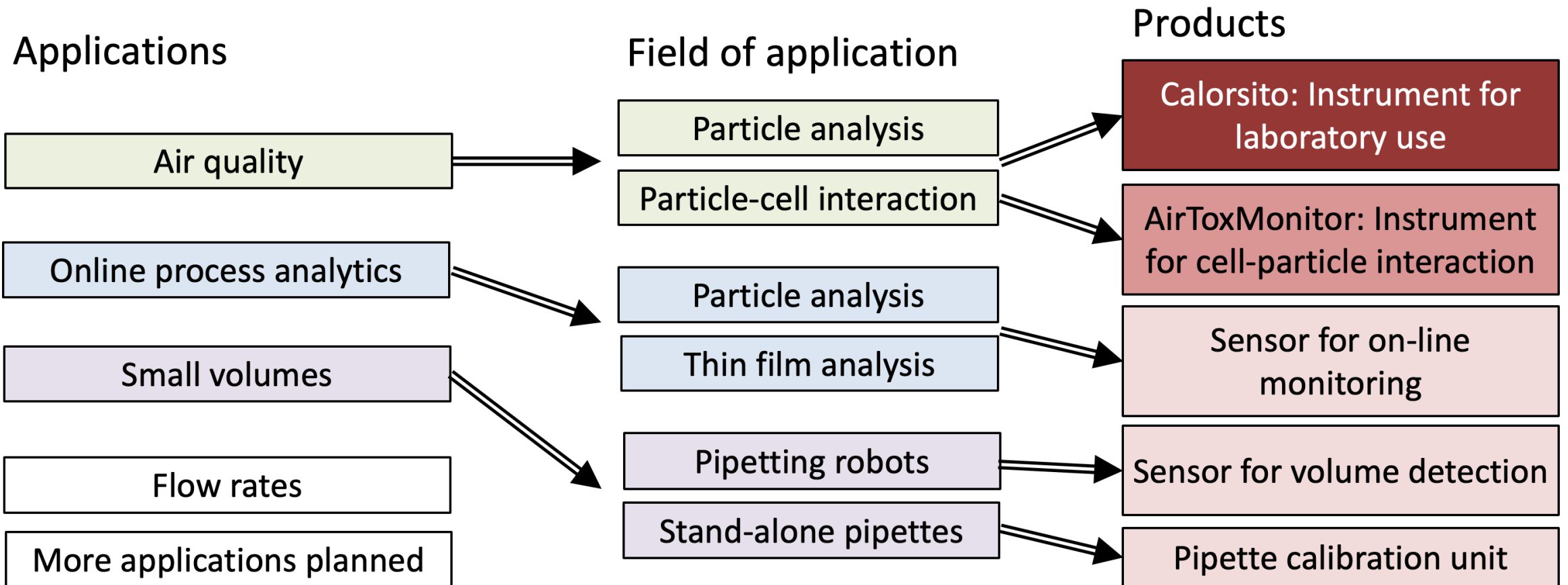
- Non-contact
- Imaging technology
- Sensitive
- Versatile

Applications

- Photovoltaic
- NDT (CRFP, wind turbines,...)
- Nanomaterials

Applications at NanoLockin GmbH

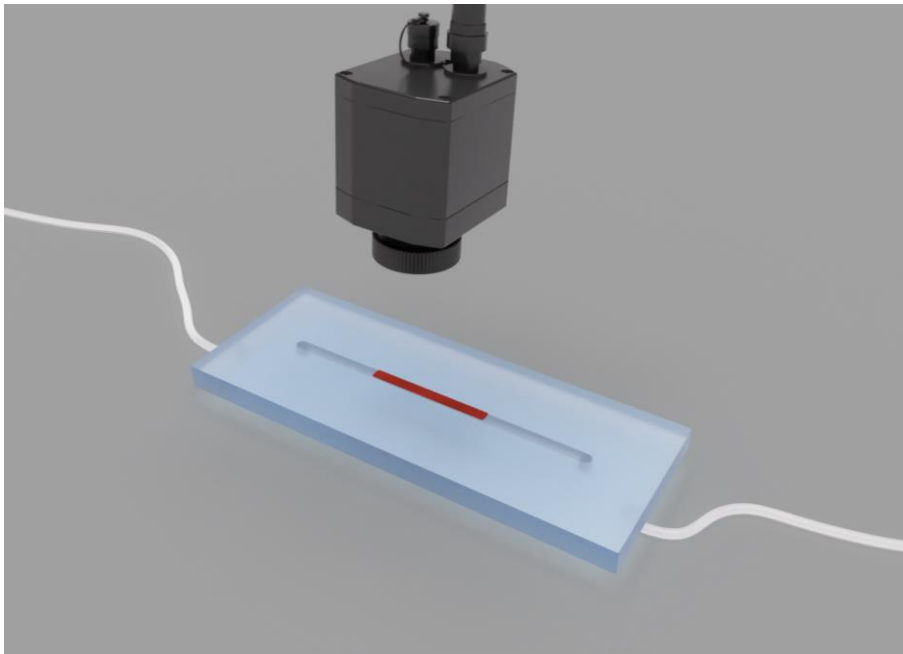
By miniaturization, NanoLockin Systems allow applications not yet possible



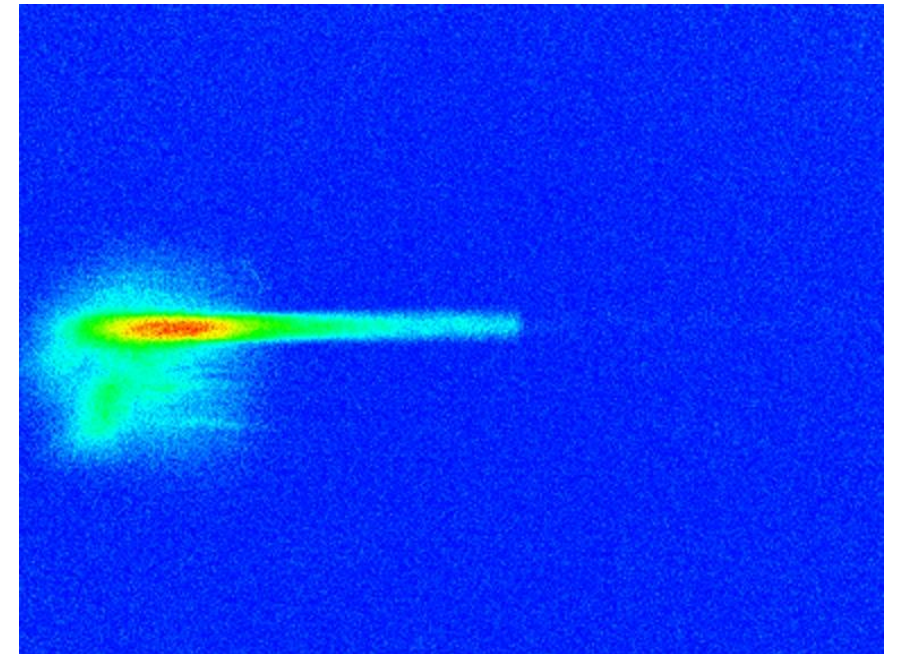
Flow Analysis with LIT

Contactless measurement of flow rate in microfluidic channel

Channel is heated and the heat is analyzed by an infrared camera/sensor



Infrared image of heated microfluidic channel

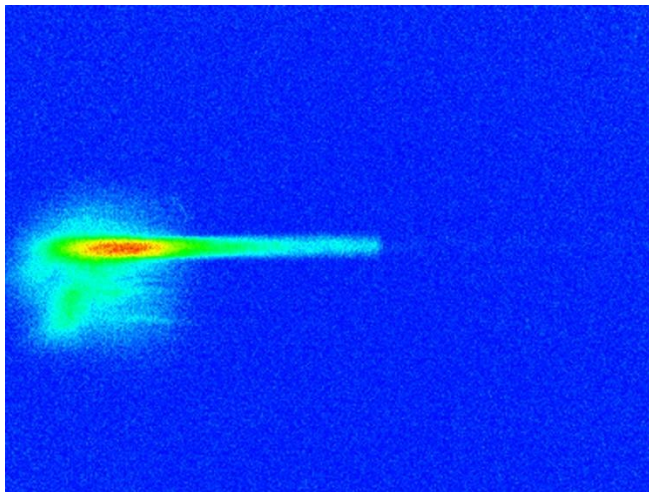


Flow Analysis with LIT

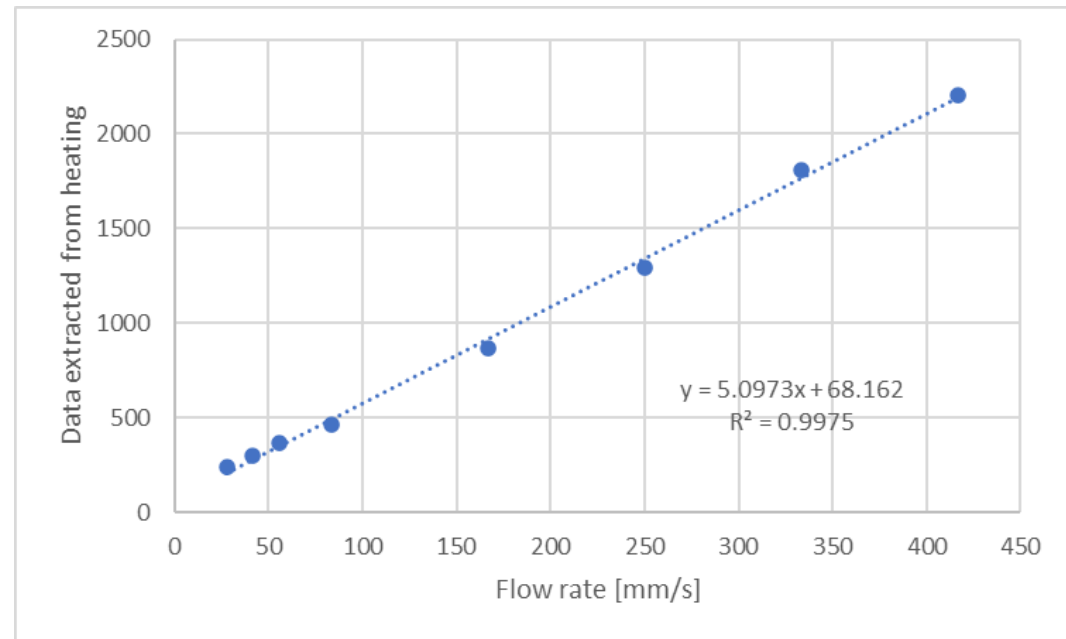
Flow rates between 0.25 and 1500 mL/min tested

Microfluidic channel dimensions:
Width: 1 mm, Depth: 0.5 mm; Length: 30 mm

No limits in size of microfluidics channels



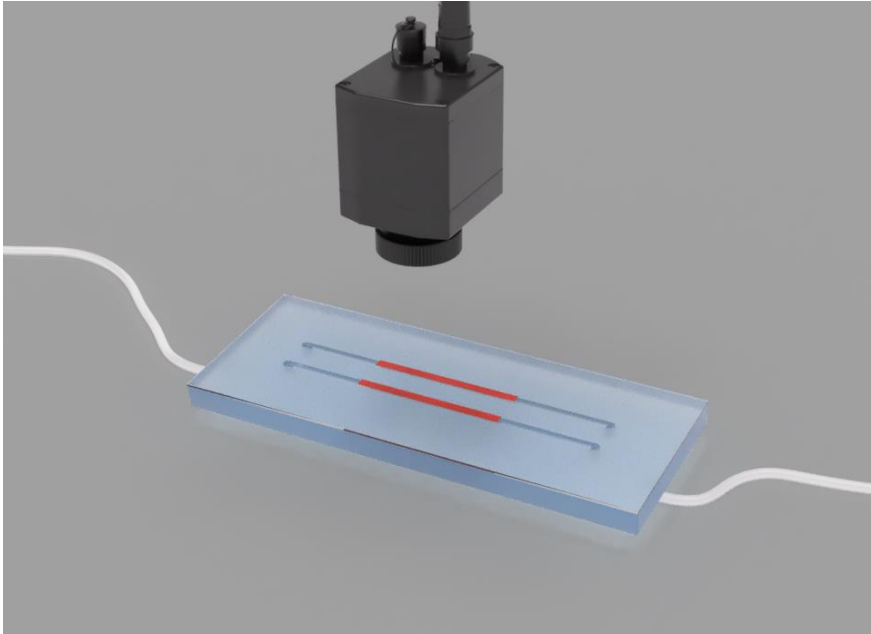
Extracted data can be correlated to the flow rate



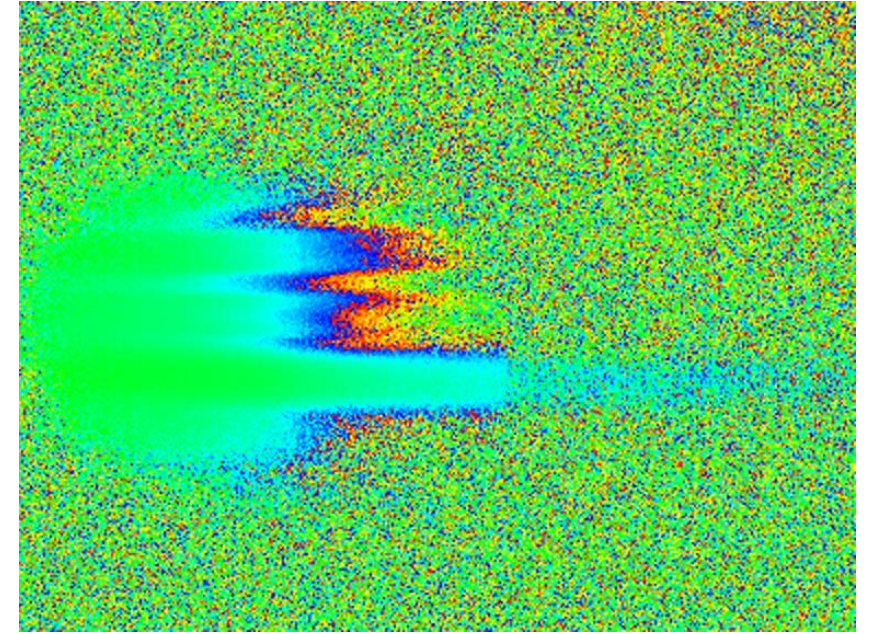
Flow Analysis with LIT

Measurement of multiple positions

Multiple channels and positions on the chip can be analyzed at the same time



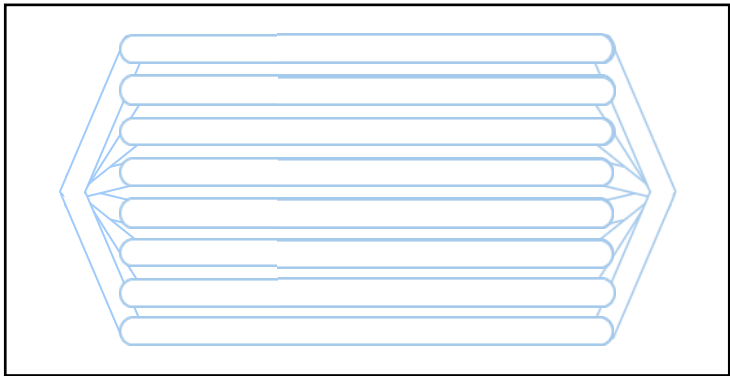
Infrared image of microfluidic chip with multiple channels



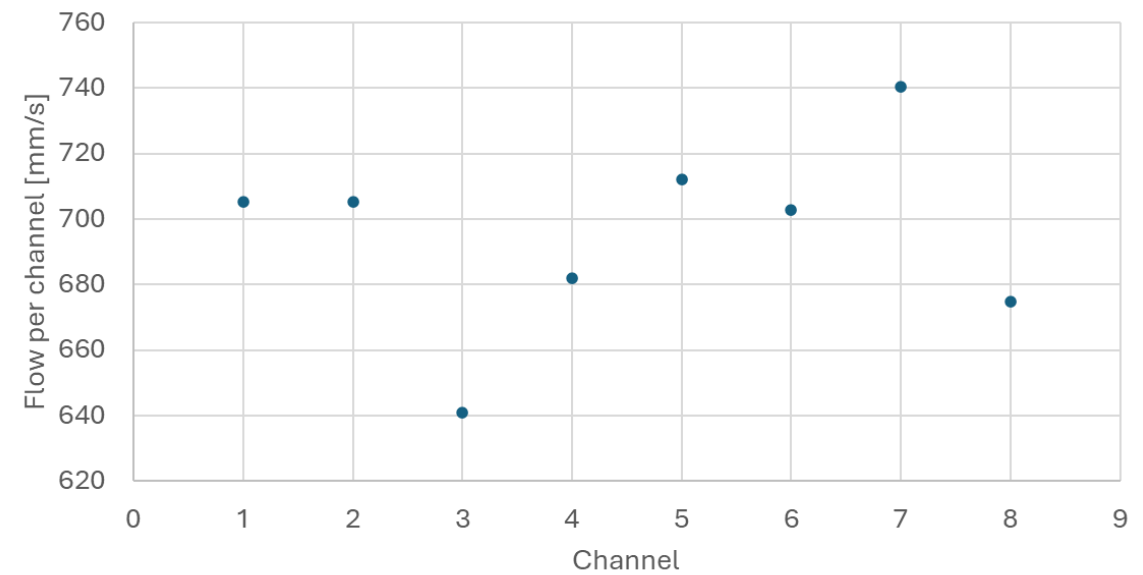
Flow Analysis with LIT

Comparing multiple channel microfluidic chip

8 Channel microfluidic chip
Non-transparent microfluidics



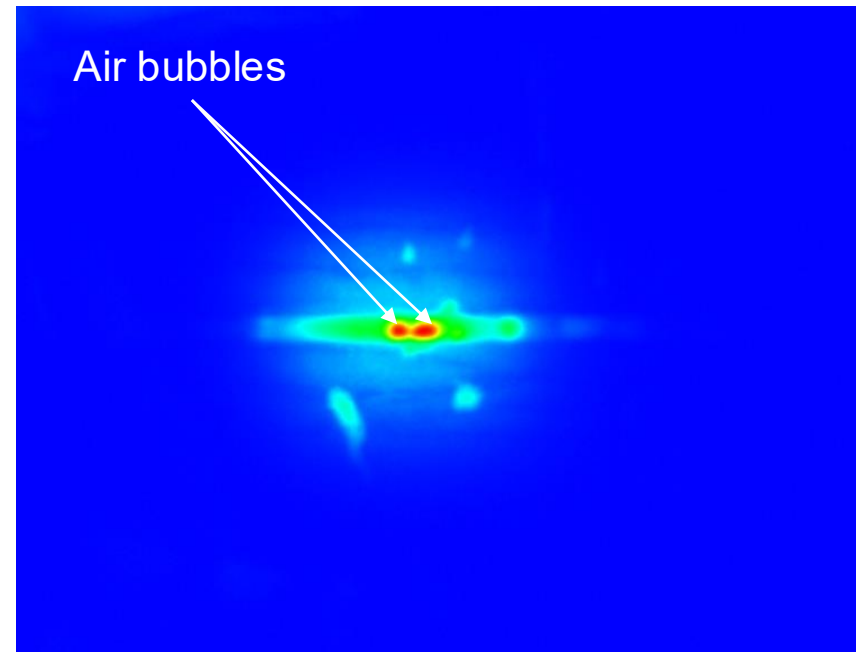
Comparison of flow rate in the 8 Channels



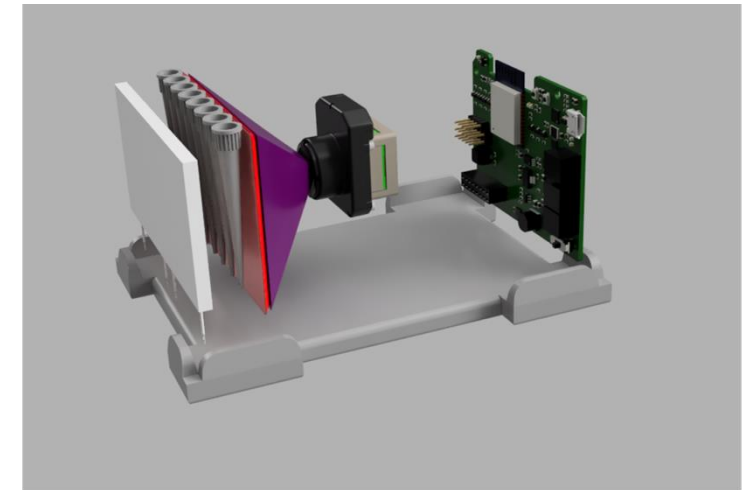
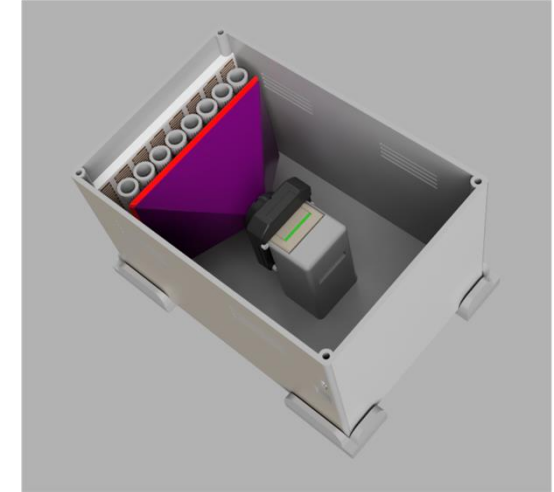
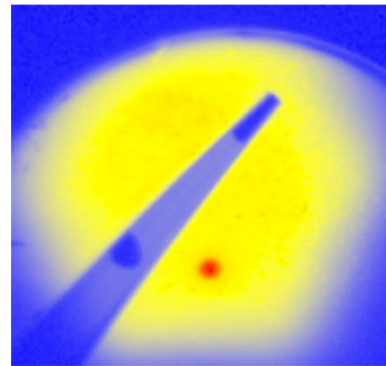
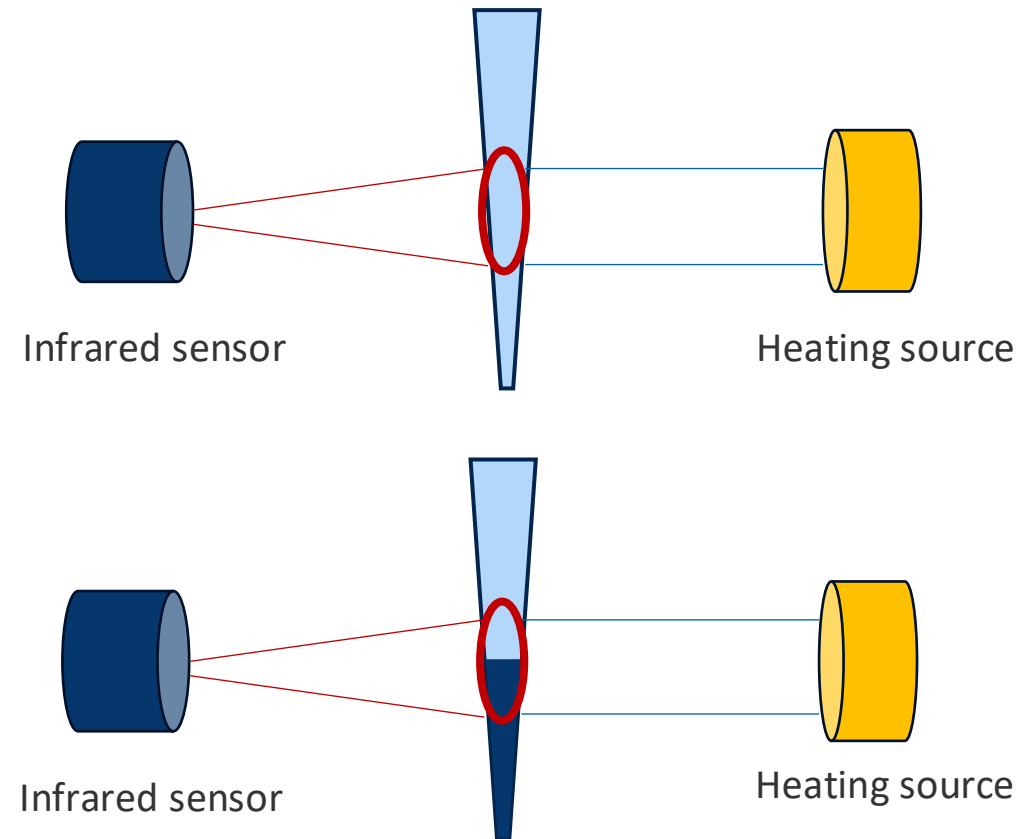
Flow Analysis with LIT

Detection of trapped air bubbles

Trapped air bubbles can be detected in the microfluidic system

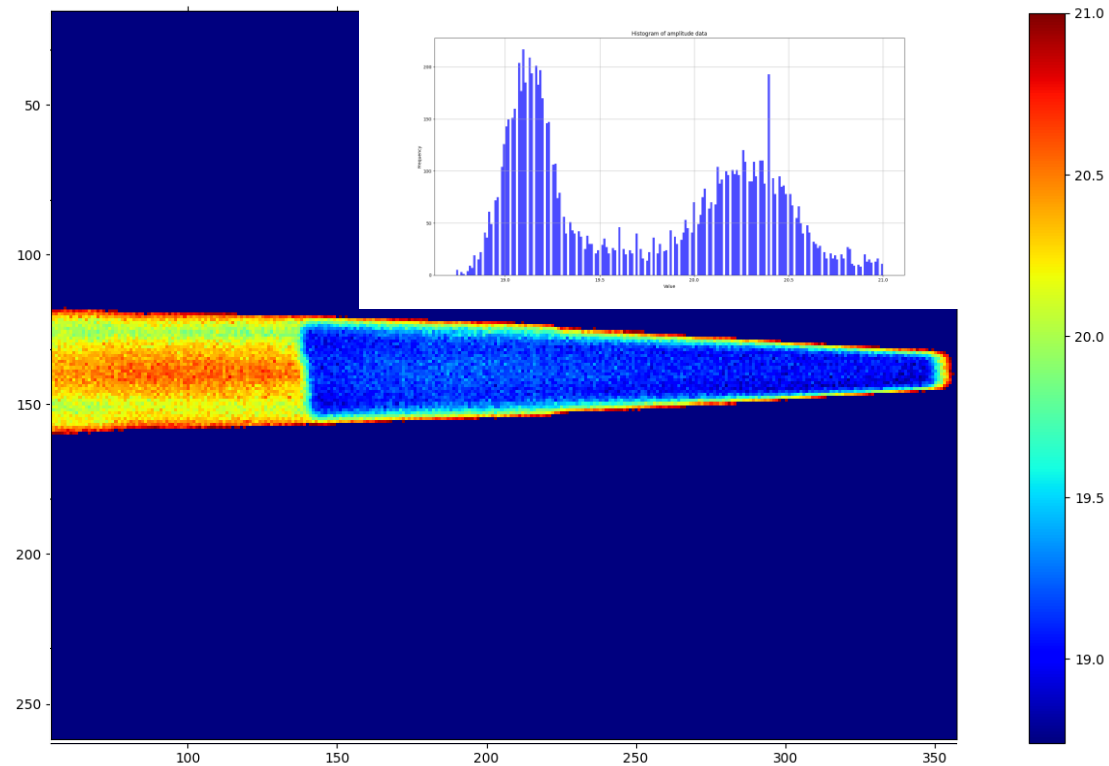


Pipette Volume Measurement with LIT

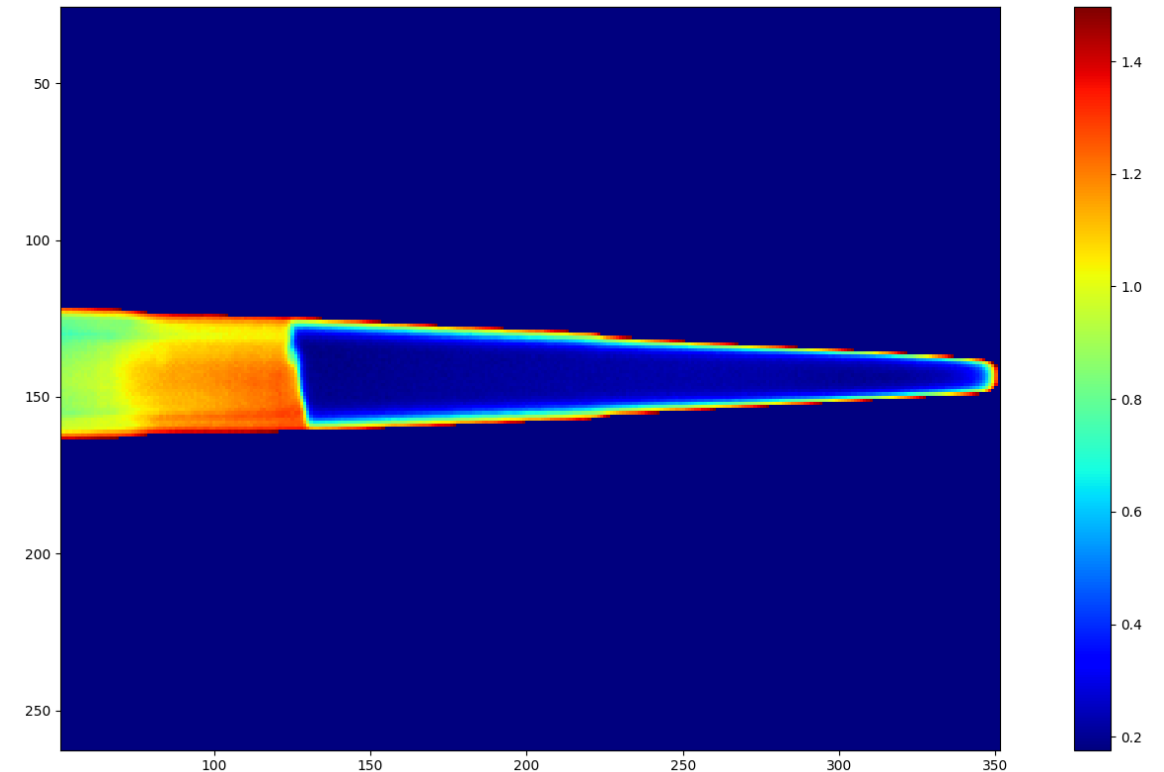


Pipette Volume Measurement with LIT

Thermal image

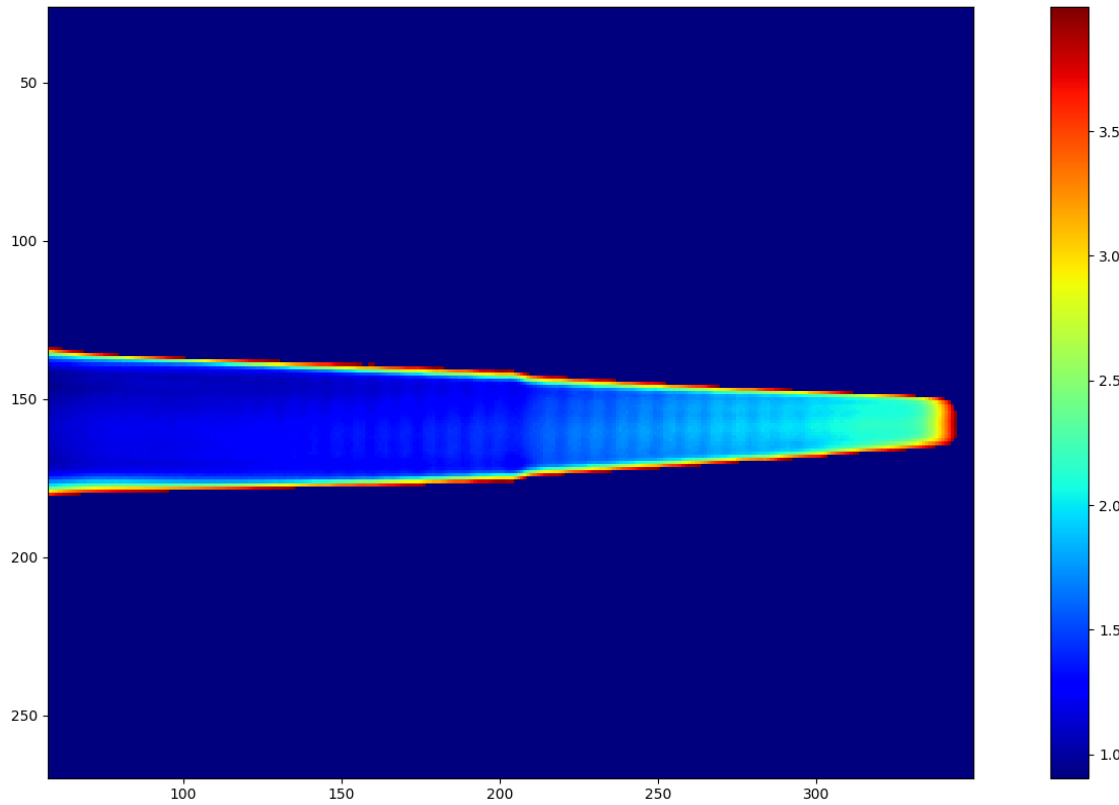


Lock-in thermography image

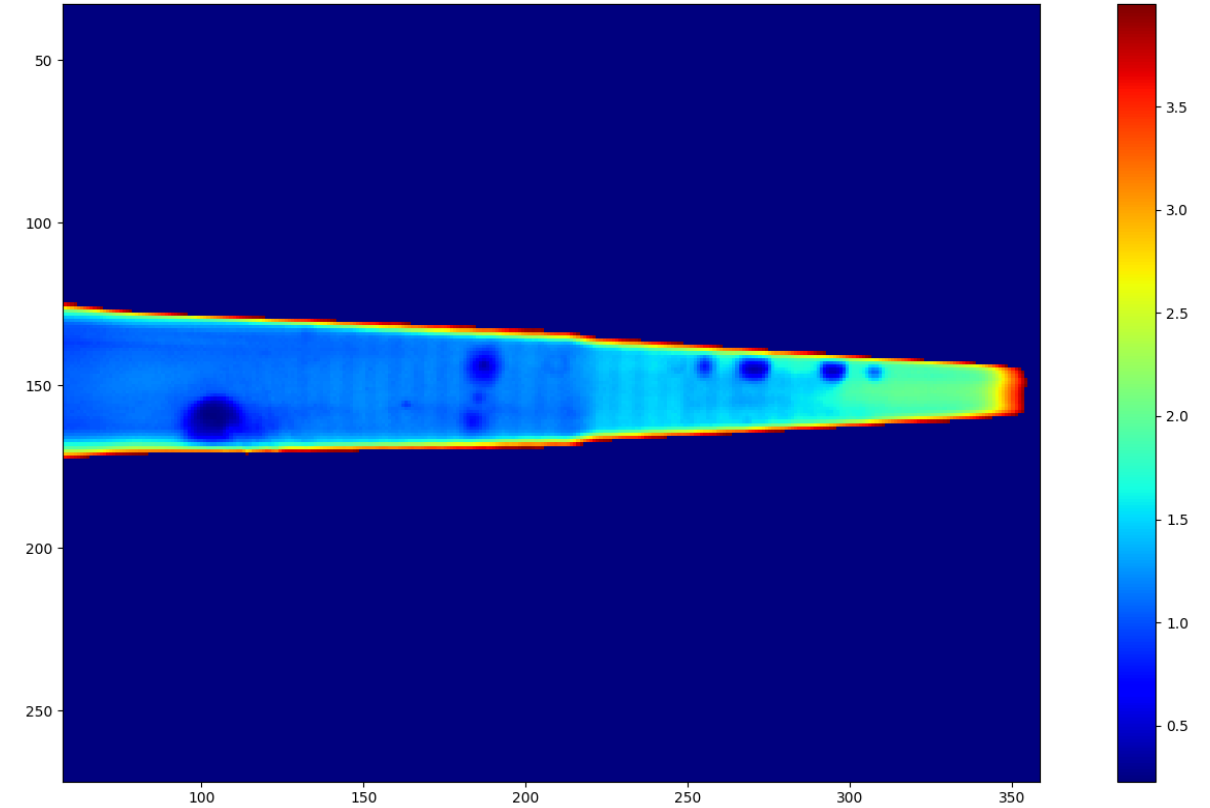


Pipette Volume Measurement with LIT

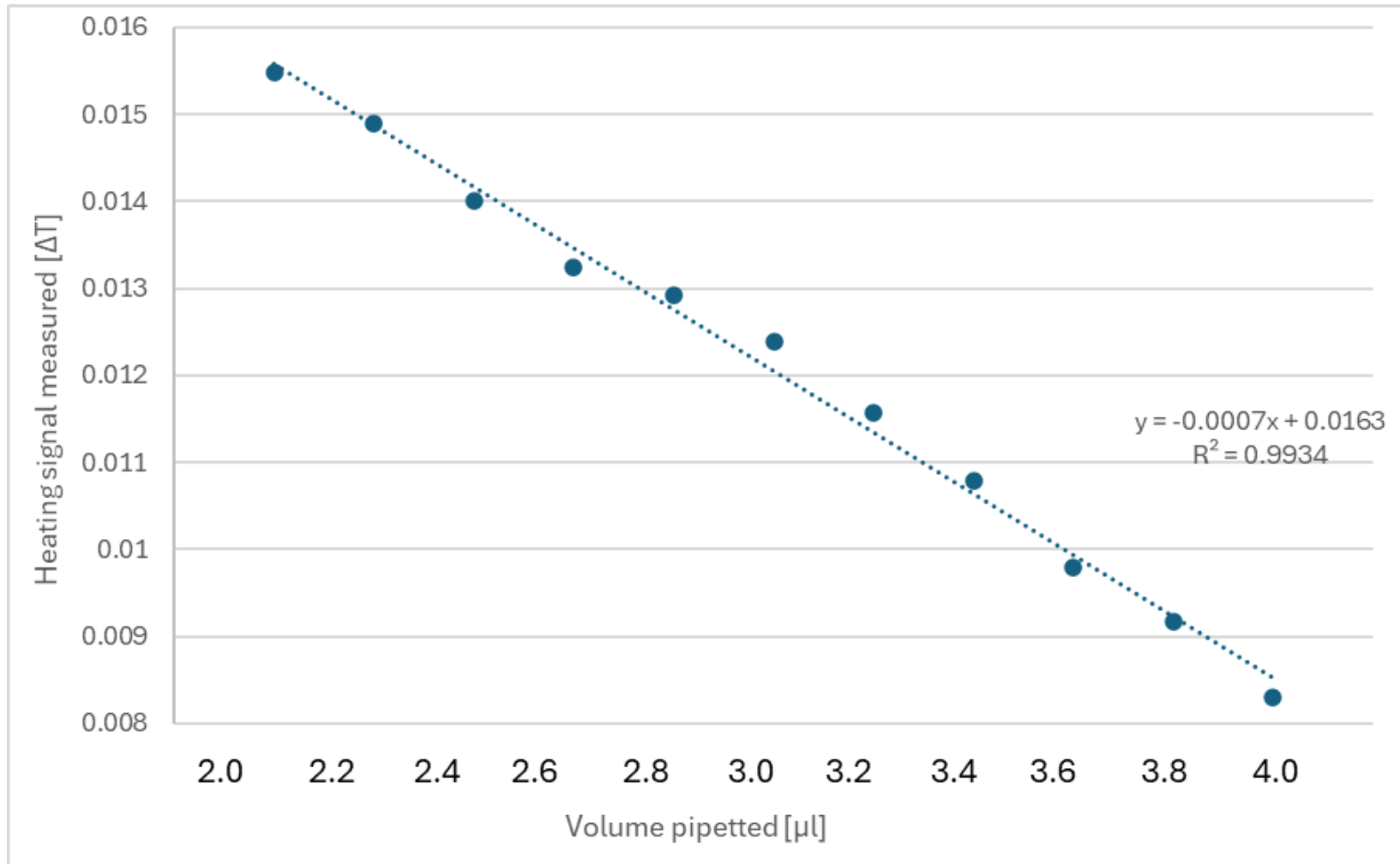
Empty pipette tip



Pipette tip with residual liquid



Pipette Volume Measurement with LIT



Pipette Volume Measurement with LIT

No need to use special liquids or reagents

Volume verification

To fit in production lines and industrial equipment

Rapid analysis

Operation at high frequencies for on-line process and quality control

High sensitivity

To detect and analyze small differences

How the methods compare	Gravimetry	Fluorimetry	Photometry	NanoLockin
Usability				
Suitable for automated liquid handlers	✗	✓	✓	✓
Quick Volume verification	✗	✓	✓	✓
Volume Verification in pipette	✗	✗	✗	✓
Total Cost (instrument, labor, reagents?)	\$	\$\$	\$\$	\$
Technical performance				
Precise	●●	●●●	●●●	●●●
Accurate	●●	●	●●●	●●●
Volume range > 200 µL	●●●	●●●	●●●	●●●
Volume range 50 – 200 µL	●●●	●●●	●●●	●●●
Volume range 10 – 50 µL	●●	●●●	●●●	●●●
Volume range < 10 µL	●	●●●	●●●	●●●
Technical performance				
Humidity	●			
Temperature	●			
Knowledge of sample density	●			
Requires specific reagent		●	●	

Example Industrial collaboration



VITROCELL® CalorQuanti

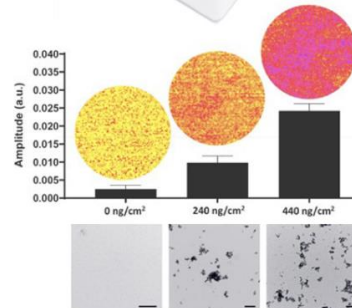
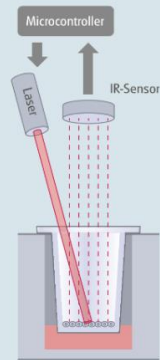
An innovative optical dosimetry tool for real-time deposition monitoring

The latest innovation of online dosimetry assessment was developed in a joint project of NanoLockin and VITROCELL®. The new CalorQuanti can be used to optically analyze the particle dose in VITROCELL® Cloud Alpha Systems or as standalone unit.

It uses an innovative lock-in thermography system, which allows to measure the heating of particles upon light irradiation. The amount of heat produced can be correlated to the deposited dose.

Function Principle

1. Laser pulses light on ALI
2. Particles and cells emit different IR-radiation
3. Lock-in thermography allows for analysis of temperatures differences in the mK range
4. The measured heat can be correlated to the particle concentration



Source: Adolphe Merkle Institute, University of Fribourg, Switzerland

Our new product CalorQuanti will be presented by VITROCELL® at the SOT in Salt Lake City, Utah (March 2024)

Together with the company VITROCELL® we developed the CalorQuanti to analyze particle doses in VITROCELL® Cloud Alpha System.

For more information:

You can find VITROCELL® at booth number 912.

<https://www.vitrocell.com/news/product-news-03-2024/>

Key Features:

- Allows for non-invasive, real-time dosimetry
- Particle deposition is measured on living cells, directly at the air-liquid interface
- Does not sacrifice a cell culture position in the exposure system
- Capable of analyzing particle types with darker color: combustion particles (e.g., diesel and aircraft emissions), tire wear particles, metal particles, brake wear particles, carbon particles (graphene, carbon black and nanotubes)
- Also available as standalone version

Thank you for your attention!

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