# Thermodiffusion of latex beads studied with a microfluidic cell

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## Introduction

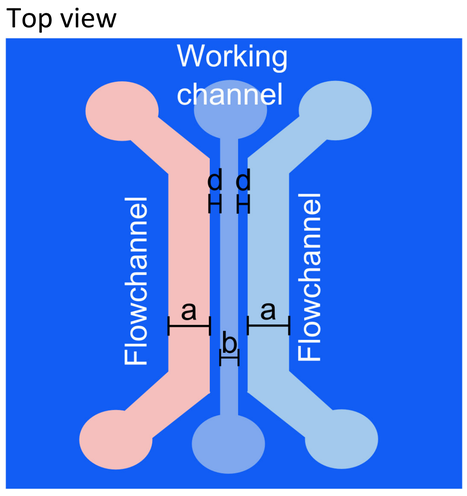
### Challenges in thermophoresis

- Current understanding of thermophoresis in liquids is not complete.
- Both theory and experiments are required.
- Most of currently used methods (optical, based on beam deflection or diffraction) are not suitable for studying thermophoresis of big colloidal particles (d>100nm) as well as for complex mixtures
- Application of thermophoresis for biosensors

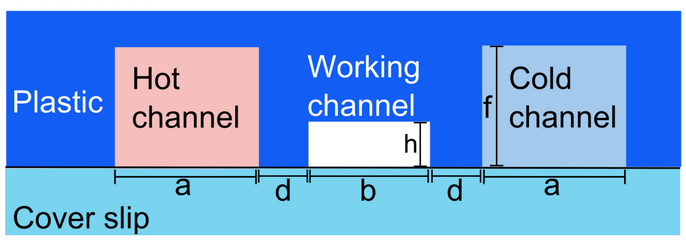
## Microfluidic cell

### Design

Top view




Cross section

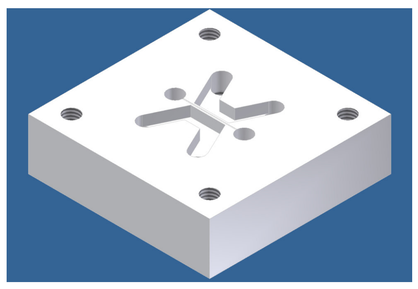



a ≈ 2mm,
b ≈ 100µm,
h ≈ 30µm
d ≈ 150µm,
f ≈ 1mm

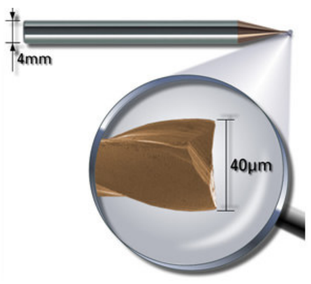

### Production

Made of Plexiglas by micromilling

CAD model

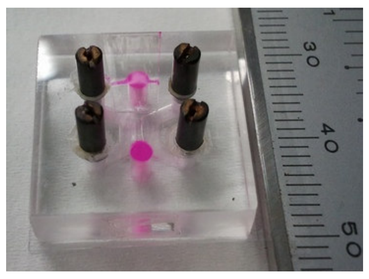


Micromill example




http://www.micro-mill.com

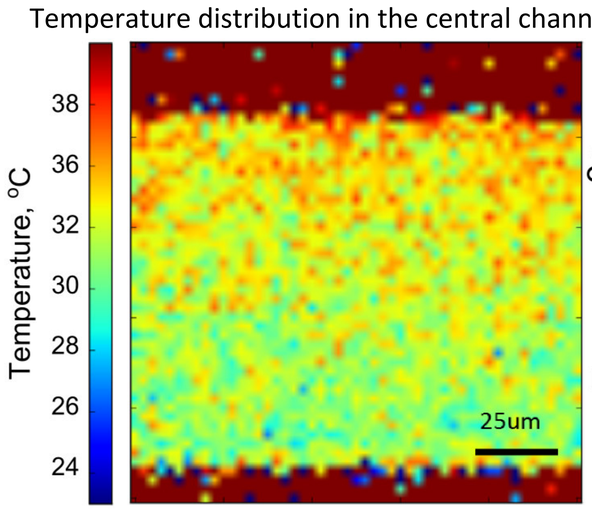
Produced cell



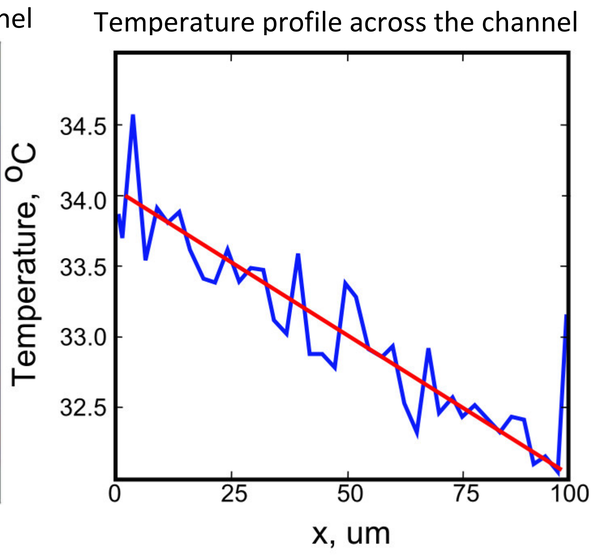

### Characterization

Fluorescence life time microscopy (**FLIM**) with Rhodamine B

Temperature distribution in the central channel




Temperature profile across the channel




### Advantages

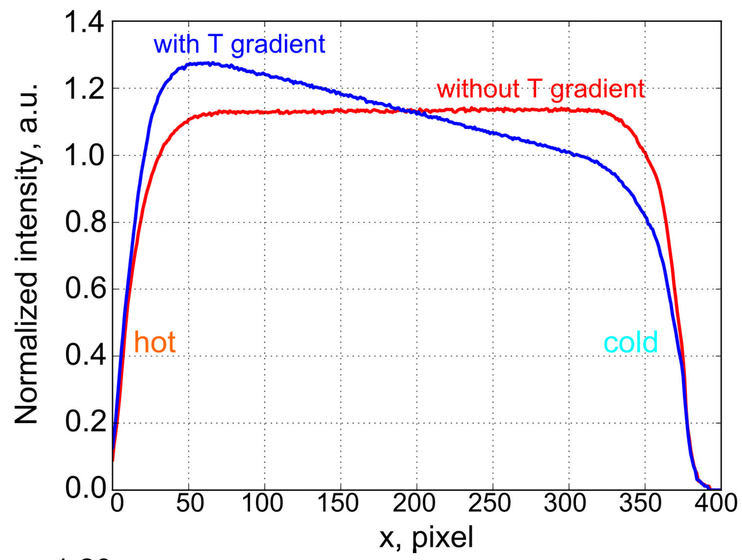
- Investigation in buffer solutions is possible
- Large colloids can be studied (>100nm)
- Complex mixtures can be investigated
- Large temperature gradient $10^4$ K/m
- Single particles can be tracked (studied)

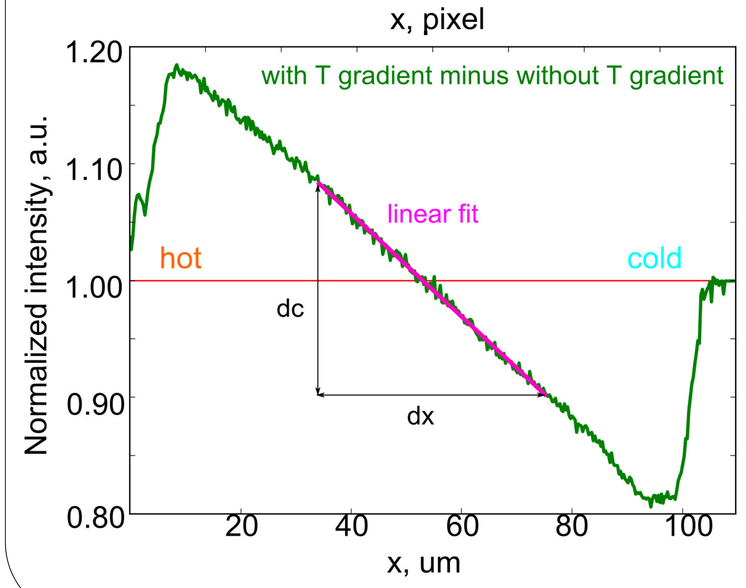
## Small particles

Latex nanobeads (25 nm) 1% in water

Thermo Scientific™ Fluoro-Max green fluorescent internally dyed polystyrene particles in water.

Particles cannot be distinguished in the microscope. Fluorescence intensity is taken as a measure of concentration




At the equilibrium when c<<1:

$$\vec{J} = -D\vec{\nabla}c - cD_T\vec{\nabla}T = 0$$

$$S_T = -\frac{D_T}{D} = -\frac{1}{c}\frac{|\vec{\nabla}c|}{|\vec{\nabla}T|} = -\frac{dc/dx}{c\ dT/dx}$$

$$S_T \approx -0.18\ K^{-1}$$

for $T = 25°C$

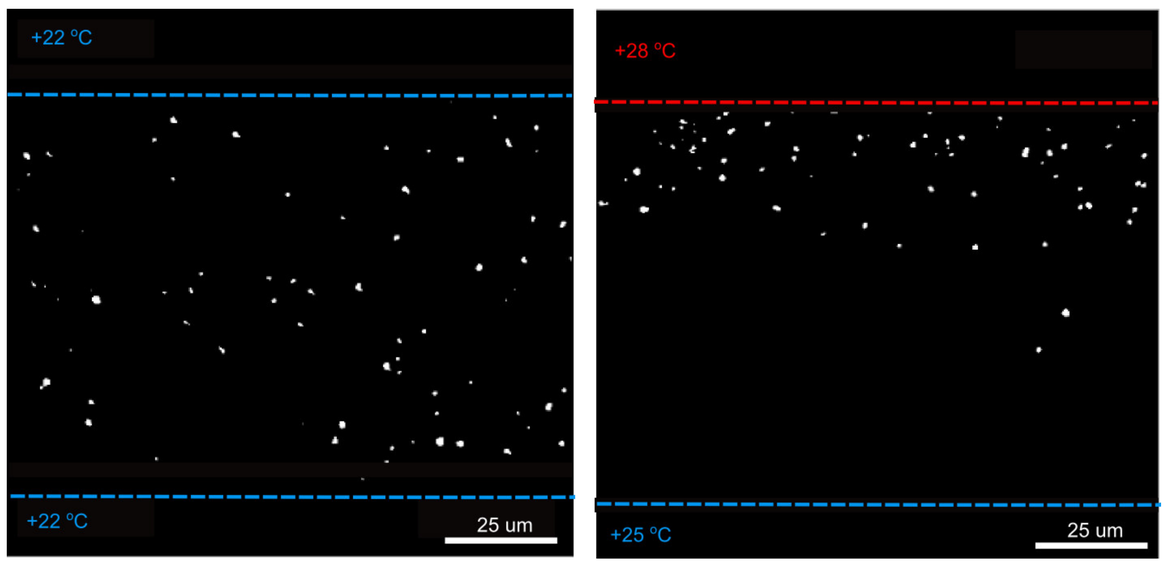
**Vaidation against TDFRS measurments is planed**

## Large particles

Latex microbeads (0.5µm) 0.01% in water

Single particles can be distinguished in the microscope and counted

Thermo Scientific™ Fluoro-Max green fluorescent internally dyed polystyrene particles in water.



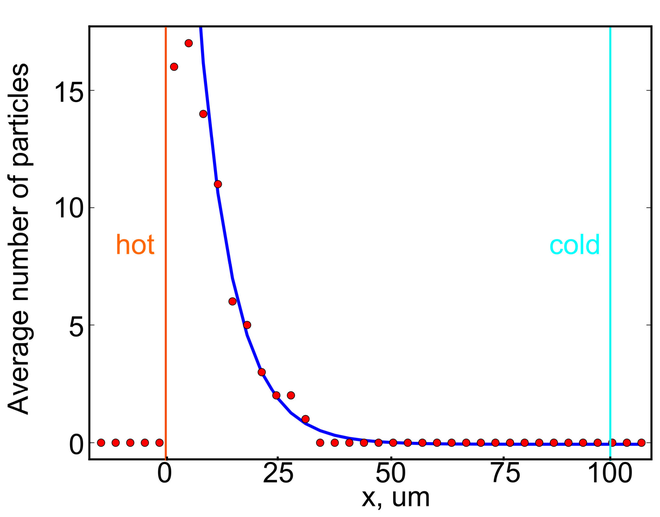

At the equilibrium when c<<1:

$$\vec{J} = -D\vec{\nabla}c - cD_T\vec{\nabla}T = 0$$

$$c = c_0\exp\left(\frac{S_T\Delta T}{L}x\right)$$

fitting

$$S_T \approx -3.0\ K^{-1}$$




The work is supported by ESMI project (European Soft Matter Infrastructure)

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