

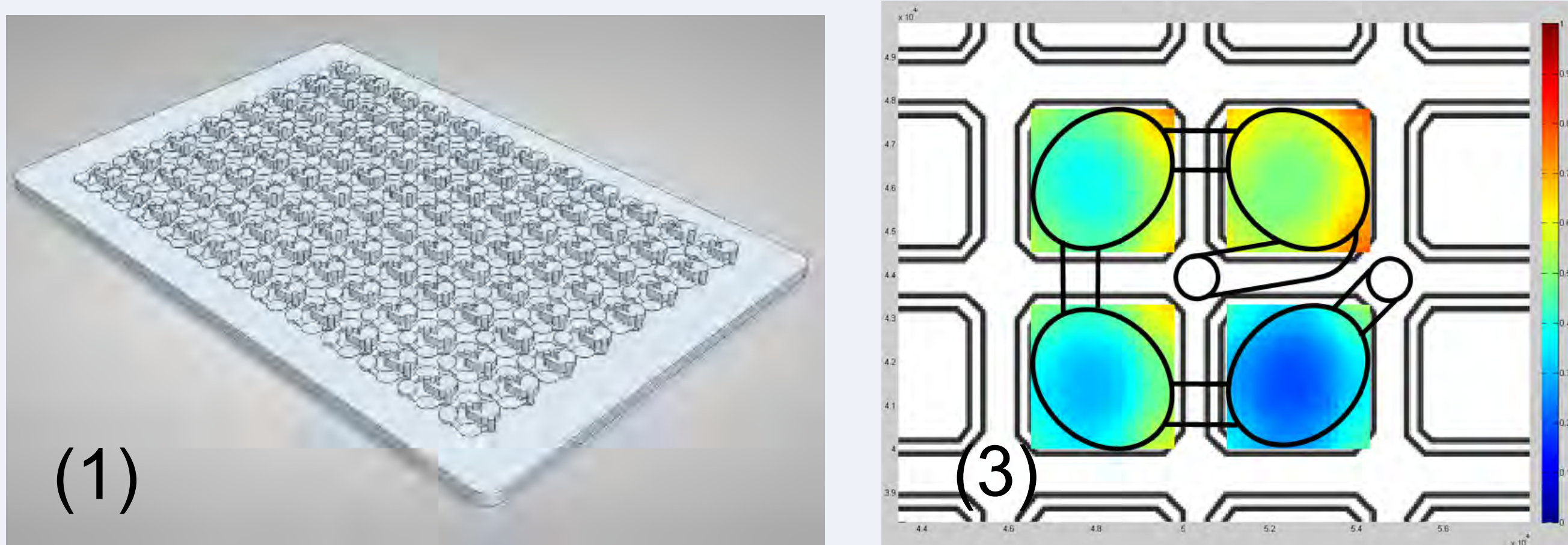
# Implementation of a Microfluidic Device for Absorption Measurements in High-Throughput Experiments

Carsten P. Radtke, Marie-Therese Schermeyer, Jürgen Hubbuch

## Motivation

- Absorption measurements in a wide concentration range
- Implementation in established microscale procedures
- Compatible with liquid handling stations (LHS) and microplate format
- Reducing the influence of dilution and meniscus

## Device Manufacturing



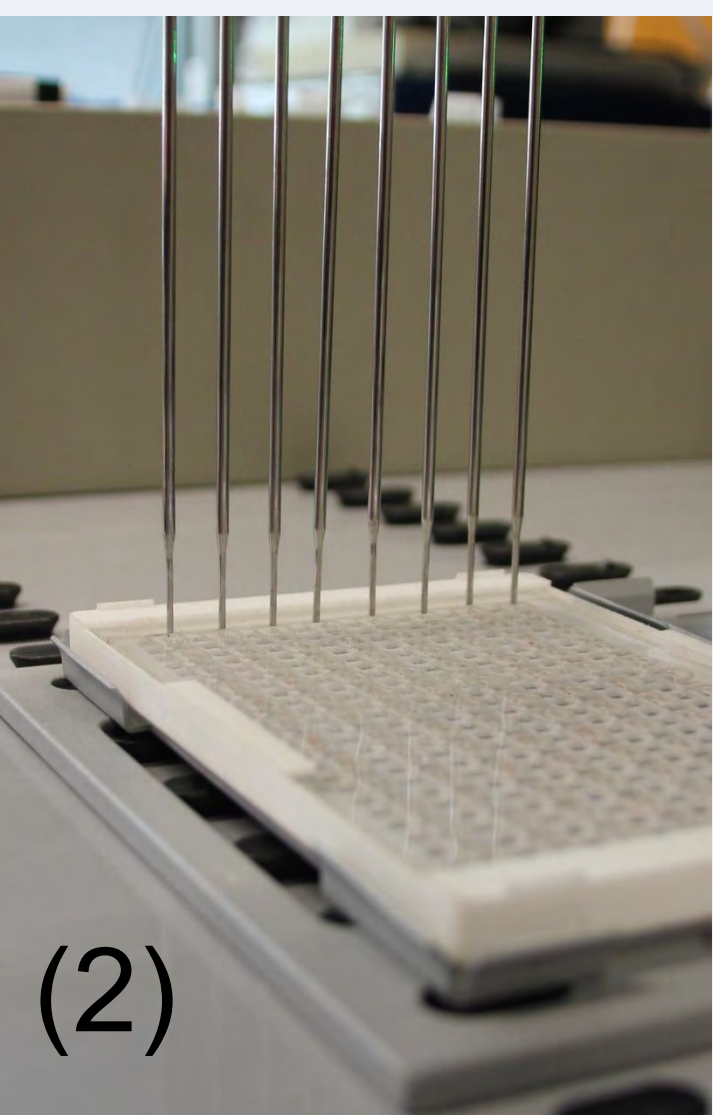
(1)

(3)

(1) CAD-model of the molding master for silicone molding<sup>[1]</sup>. The microfluidic ( $\mu$ F) chip device provides a total of 96 channel structures with 4 measurement chambers (height of 1500, 1000, 600 and 100  $\mu$ m)

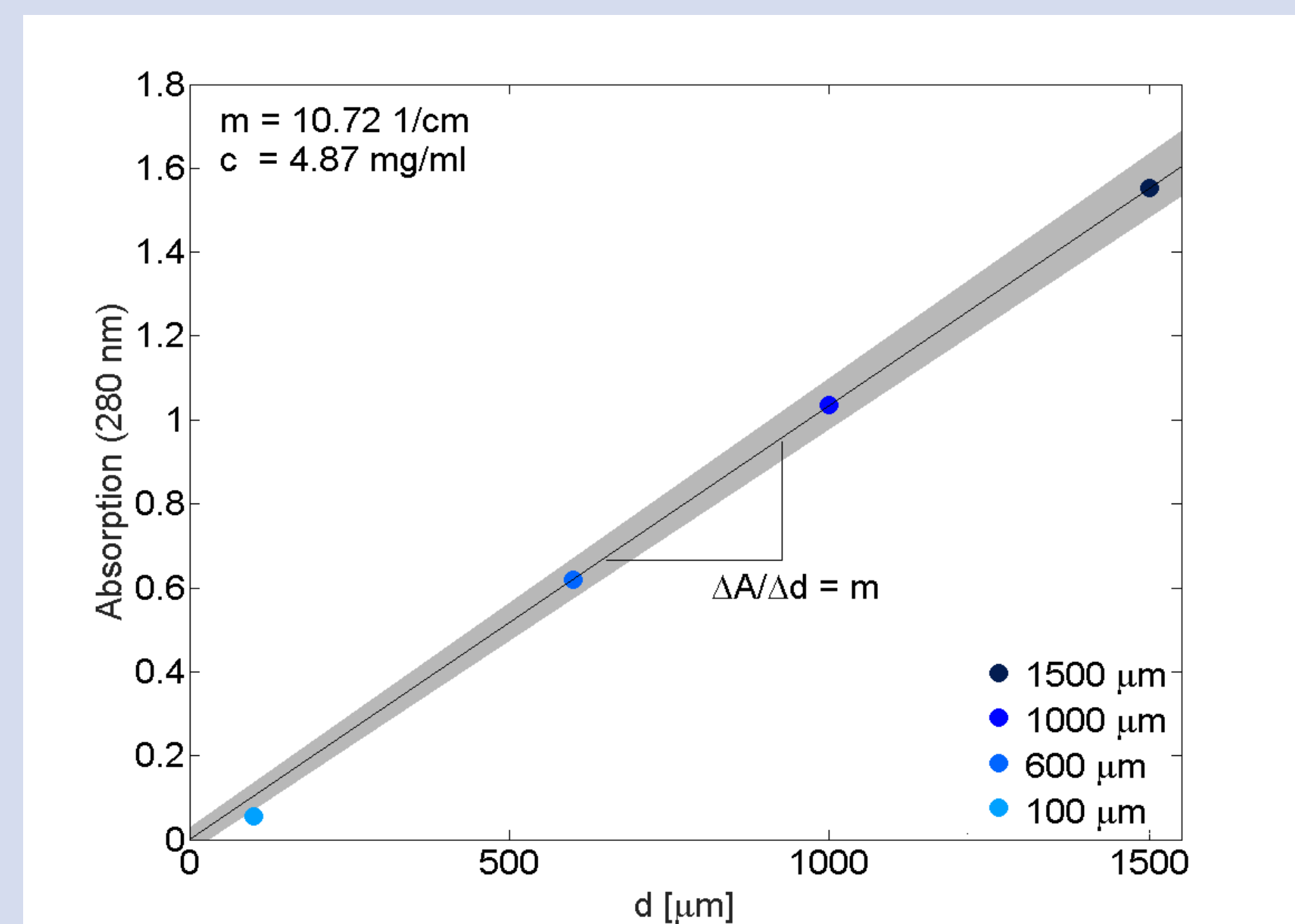
(2) Filling process of the channel structures by the tips of the LHS

(3) Visualization of absorption data to illustrate the gradient of the measurement values dependent on the channel heights



(2)

## Linearity



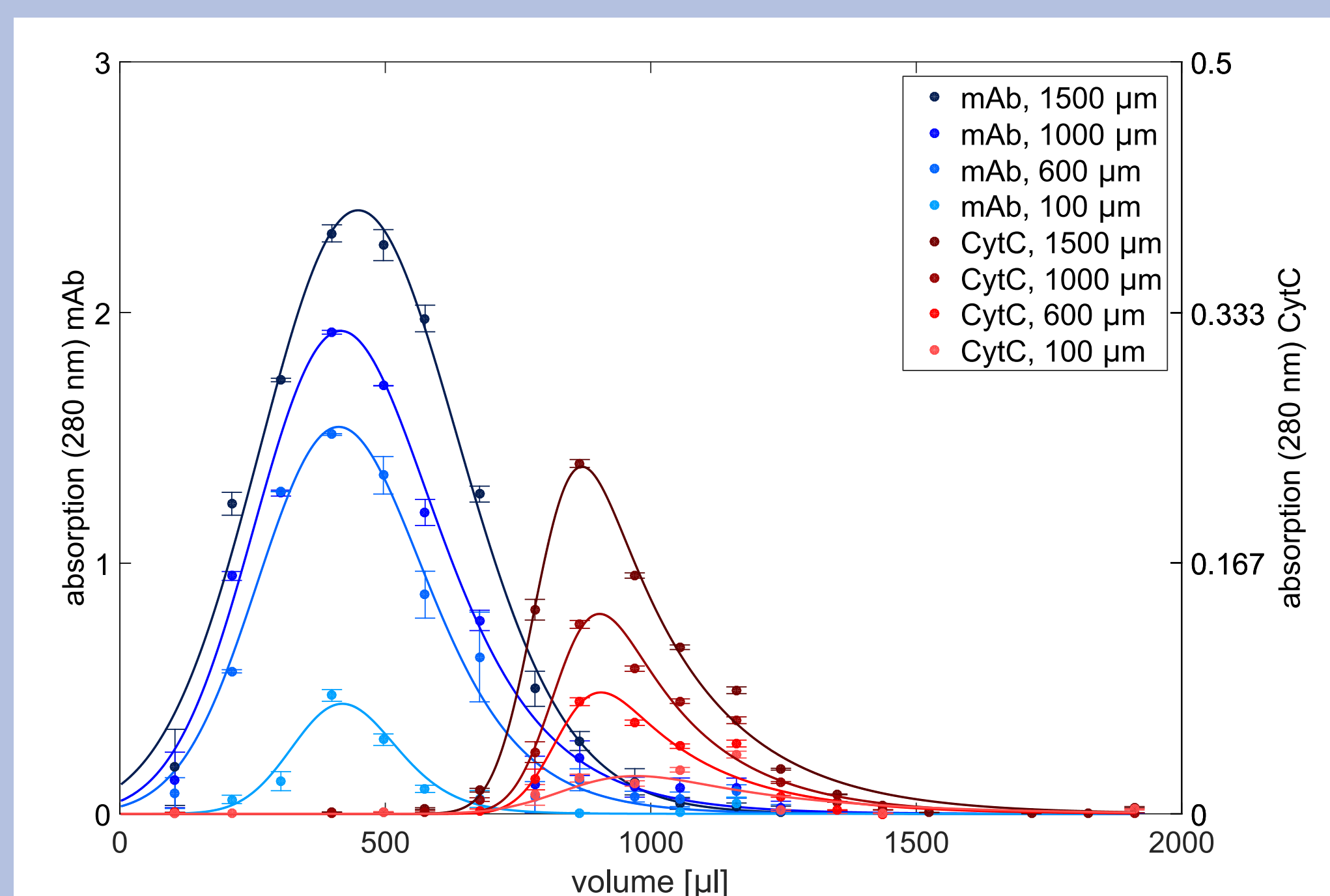
Lysozyme absorption values plotted against the channel height

The application of slope method allows the determination of the extinction coefficient (or the concentration respectively)<sup>[2]</sup>

$$\epsilon_{\lambda} = \frac{m}{c}$$

Separation of mAb and CytC in microliter scale on a LHS<sup>[3]</sup>

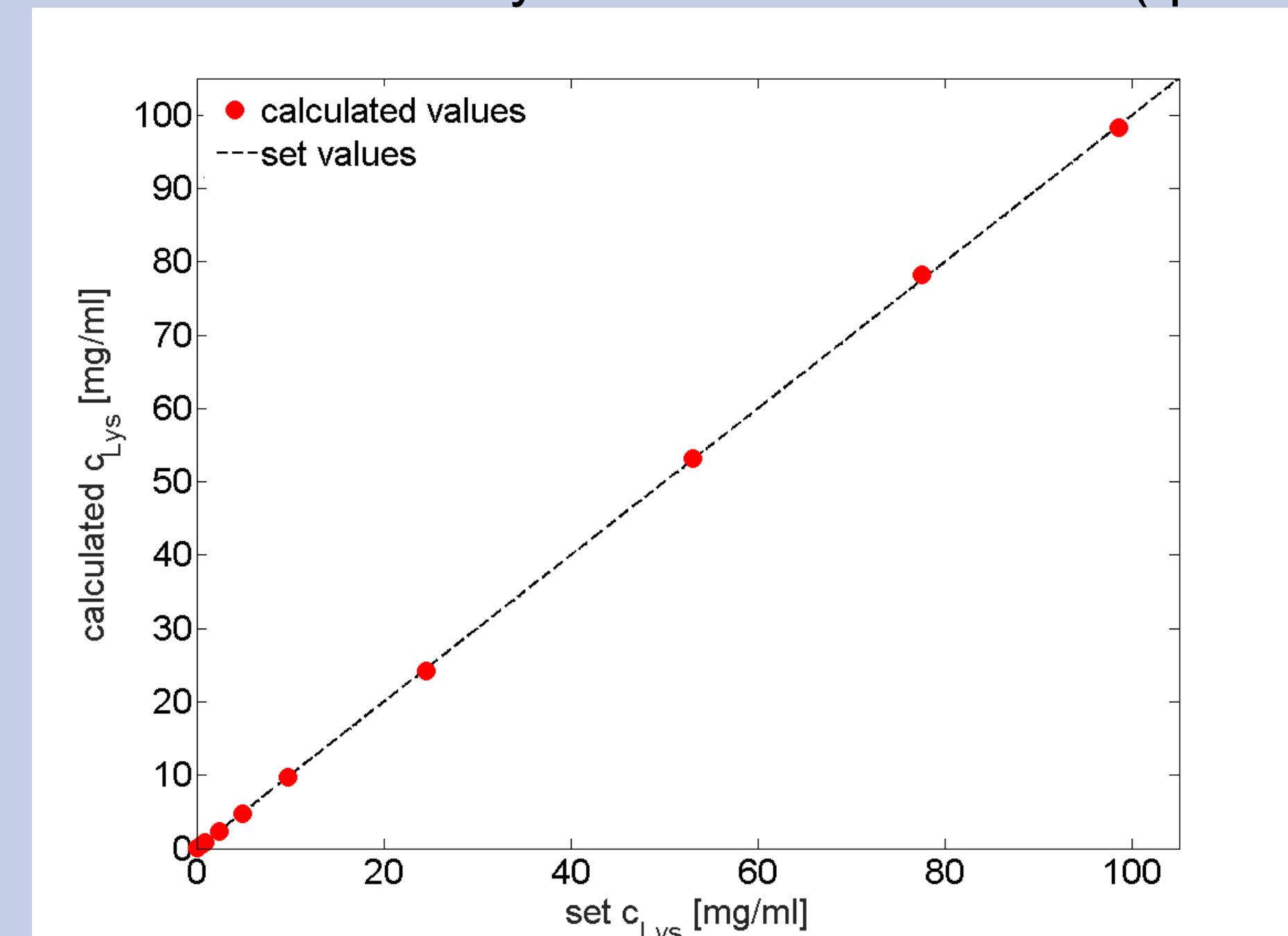
- Measured data could be fitted with a characteristic elution curve
- Mean standard deviation of 3.5% in  $\mu$ F-device compared to 8.2% in microplate measurements
- mAb concentration **up to 140 mg/mL** could be measured without dilution



Elution profiles of mAb (blue) and CytC (red). Plotted are absorption values measured in the four chambers of the  $\mu$ F-device

## Concentration Range

- Determination of concentration within the upper or lower detection limits (here 0.0001 and 2.3 OD) based on Lambert-Beer law in the highest and lowest chambers
- An absorption range from **0.1 to 100 mg/mL** lysozyme could be verified
- Determined accuracy from **99.0% to 99.9%** (quadruplicate)



Lysozyme concentrations based on  $\mu$ F-device measurements plotted against set concentration values

## Conclusion

- **Wide concentration range with high accuracy, repeatability and linearity**
- Gathering of spectral data possible
- **Successful implementation in high-throughput procedure**
- **Promising alternative or supplement to existing devices**

### References:

- [1] Waldbaur, A., Kittelmann, J., Radtke, C.P., Hubbuch, J., et al., Microfluidics on liquid handling stations ( $\mu$ F-on-LHS): an industry compatible chip interface between microfluidics and automated liquid handling stations. *Lab Chip* 2013, 13, 2337–2343.  
 [2] Thakkar, S. V., Allegre, K.M., Joshi, S.B., Volkin, D.B., et al., An application of ultraviolet spectroscopy to study interactions in proteins solutions at high concentrations. *J. Pharm. Sci.* 2012, 101, 3051–3061.  
 [3] Radtke, C.P., Schermeyer, M.-T., Zhai, Y.C., Göpper, J., Hubbuch, J., Implementation of an analytical microfluidic device for the quantification of protein concentrations in high-throughput format, *Eng. Life Sci.* 2016, 16 (6), 515–524.

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