# Experimental determination of mass transfer coefficients in two-phase flow at high pressure in a micro capillary

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In order to scale new green chemical processes using water and supercritical carbon dioxide, knowledge of thermodynamic and transport properties are essential. In this study, a micro capillary is used as a tool to improve the knowledge of mass transfer behavior in gas-liquid flow under high pressure. The studies of gas-liquid flow in microreactors are numerous at ambient conditions. However, neither gas-liquid models nor liquid-liquid models under ambient conditions can account for two-phase (fluid-liquid) mass transfer behavior under high pressure. The objective of the current study is the development of a method for the investigation into the mass transfer behavior of gas-liquid Taylor flow at high pressure considering the specificities of high pressure in the treatment of experimental results.

Two experimental methods for the measurement of mass transfer between two phases in a micro capillary tube are explored, the first one being a Raman spectroscopy method based on the set-up of Klima and Braeuer (2019) where a Raman signal is obtained from the liquid phase. This signal allows to compute the molar fraction of carbon dioxide dissolved in the liquid phase versus the length of the capillary. Coupled with a thermodynamic model, the concentration of gas dissolved is obtained from the $CO_2$ molar fraction. Volumetric mass transfer coefficients are then obtained as a function of the length of the capillary

The second method is based on the colorimetric technique of Andersson et al. (2018) using a tracer molecule (Bromophenol blue) that is sensitive to pH changes, used to visually detect the amount of carbon dioxide dissolved in the liquid phase by quantification of the acidification.

Both methods allow the volumetric mass transfer coefficient to be determined at various axis locations inside the micro-capillary and open the investigation of operating conditions effects (temperature, pressure, flowrates) on this property.

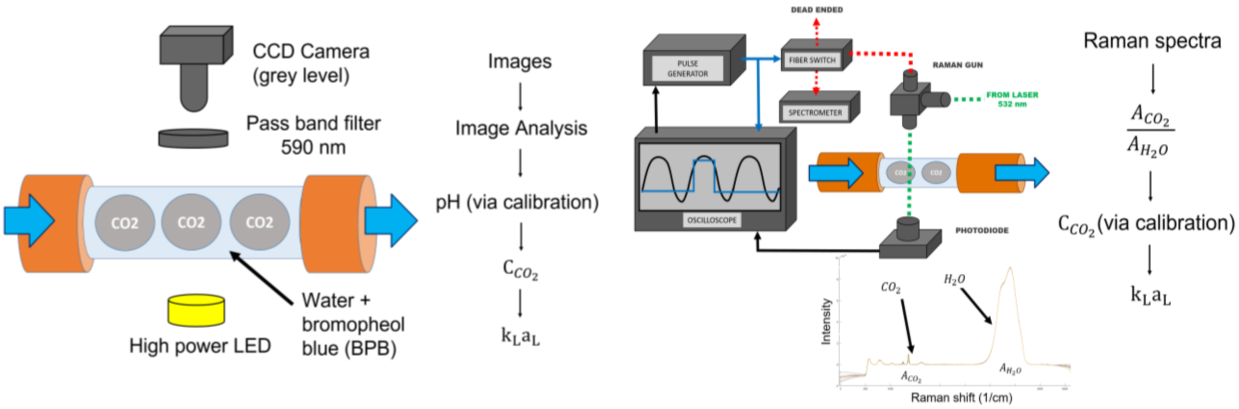


Figure 1: Colorimetric method (left) and Raman Spectroscopy Method (right).

## References

Andersson, Martin, Rodriguez-Meizoso, Turner, Hjort, and Klintberg. 2018. « Dynamic pH determination at high pressure of aqueous additive mixtures in contact with dense CO2 ». The Journal of Supercritical Fluids 136: 95‑ 101. https://doi.org/10.1016/j.supflu.2018.02.012.

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