Chiral Recognition – Investigated by IC-calorimetry and Microgravimetry

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Chiral recognition and separation are of significant scientific and industrial interest, especially in life sciences and pharmacology. Thermodynamics of chiral recognition play a key role for the understanding of enantiomer discrimination by chiral chemical or biological receptors, e.g. at chromatographic columns, sensors etc. Known thermodynamic data are usually based on the van't Hoff analysis of temperature dependent chromatographic data. However, this procedure is subject of current disputation [1].

In this contribution a combined microcalorimetric and microgravimetric method for a direct study of the thermodynamics of enantiomer-receptor interactions in thin layers is presented. The calorimetric measurements were performed using an optimized gas-flow microcalorimeter based on a miniaturized integrated circuit (IC-) calorimeter designed recently in our laboratory [2]. This IC-calorimeter is capable of measuring the heats of absorption of vapours into thin receptor coatings with a maximum resolution of 60 nJ. Microgravimetric measurements in order to determine the amount of enantiomer absorbed under similar experimental conditions, which is necessary to calculate the molar quantities, were carried out by means of a custom-built quartz crystal microbalance (QCM). This QCM permits the determination of mass changes due to enantiomer absorption with a resolution of 0.65 ng.

The potential of the method is demonstrated by concentration dependent absorption measurements of the pure enantiomers of 2-chloropropionic acid into chiral (modified cyclodextrins) and achiral (polydimethylsiloxane) receptor coatings. All results could be consistently described by a thermodynamic model considering the contribution of specific as well as non-specific interactions. Thermodynamic data derived from the model will be discussed in terms of the chromatographic separation behaviour and mechanism and compared to literature values based on a van't Hoff analysis of chromatographic results. The advantages, features and future potential of the presented method will be highlighted.

References

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