INTRODUCTION

It is known that sugars influence the structure of the H-bond network of water and thereby change its physical properties, such as the freezing point and the glass temperature. This ability to influence the properties of water differs from sugar to sugar. One of the sugars strongly affecting water is trehalose, which is used as “anti-freeze” by tardigrades, bacteria, crustaceans and plants.

The interactions between water and saccharides are in part due to the formation of H-bonds. The rate at which the HD-exchange of saccharides takes place should be an indication for the rate with which it forms and breaks H-bonds. The HD-exchange of solvated sugars is, however, a fast reaction, which can not be monitored with common techniques for the infrared spectroscopy of reactions.

In this work we present FTIR measurements taken of the HD-exchange of two important disaccharides with our micro fluidic mixing device. We also show, that model based CoS not only makes the interpretations of the measured data easier, but also gives additional information, which is not available with common methods.

MEASUREMENT, MCS, MODEL BASED COS

All rate constants in ms^{-1}

Band assignments according to [3]

MALTOSE

TREHALOSE

RESULTS

We were able to observe the HD-exchange of disaccharides under an FTIR microscope, which is only possible with a microfluidic mixing device. From these infrared spectra, we were able to calculate the rate coefficients for the HD exchange of several functional groups of two different disaccharides. We applied model based CoS to our data and were thus able to easily find changing bands in our spectra and get estimates for the rate constants where they could not easily be determined by integrating the area under a band. The rate constants determined for trehalose are higher than corresponding constants of maltose.

The positive and negative signs of the correlation peak shows whether the underlying band stems from a functional group interacting with H$_2$O or D$_2$O.

A limiting factor, at the moment, is the pressure drop inside the mixer channel. With our current design, flow speeds beyond 375µm ms$^{-1}$ can not be achieved, which makes the area under a band hard to determine. More powerful infrared sources, like Quantum Cascade Lasers would still be able to penetrate even highly absorbing analytes.


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