Advanced concepts for understanding mass transfer processes of gases in porous solids using the frequency response method

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The Frequency Response ("FR") method can be used to characterize adsorption/diffusion properties, to determine kinetic parameters, and to elucidate the structure of porous materials. These are key factors in the development of novel high-performance materials for a wide range of technical applications. A quick determination of the properties of the pore system and its accessibility for certain molecules is crucial for the optimization stage of industry-relevant catalyst/fluid systems. In addition, predictions about the characteristics of the porous system can shorten the material development time.

For the FR method, a small perturbation in form of a periodic volume modulation - performed over a range of frequencies - induces mass transfer processes within a closed gas/solid system, which can typically be investigated by means of amplitude change and phase shift between input and output signal [1, 2]. A corresponding batch reactor system is used and novel approaches for the interpretation, to gain deeper insights into mass transfer processes at microscale level, are introduced. These new research paths, such as numerical simulation models (Figure 1), will be presented in this work.

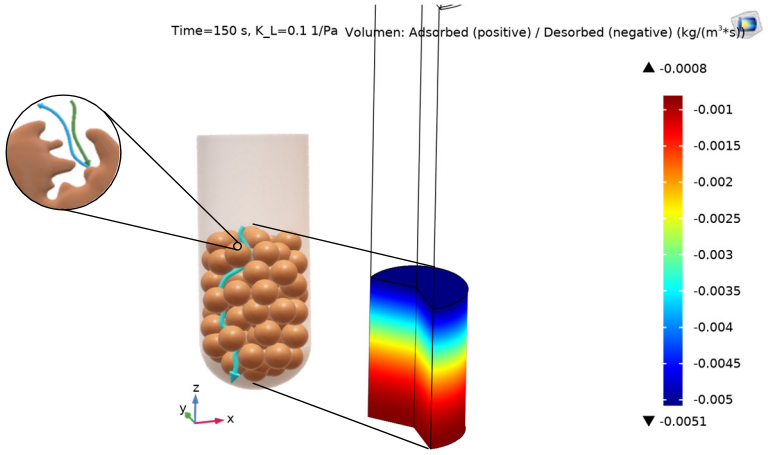

Figure 1: Illustration of a packed bed with simplified mass transfer processes of fluid molecules and exemplary simulation result (mass adsorption/desorption rate per volume unit) [3].

References

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