Transport of isopropanol in H-ZSM5 by impedance spectroscopy

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The transport of gases/liquids in meso- and micropores of catalysts is the first important step in the microkinetic cycle. Diffusion processes may significantly influence the catalytic activity and selectivity. As zeolite structures are well-known, those materials are used for studying the influence of diffusion on the catalytic activity. H-ZSM5 represents a well-defined material with strong Brønsted acid sites. It has two types of pores: mesopores and micropores [1]. Due to the complexity of the mechanism of diffusion processes in different pore structures in such zeolites, traditional techniques (such as TAP, FR) are restricted with respect to the range of diffusion coefficients. New approaches are needed for revealing exact values of diffusion coefficients.

Electrochemical impedance spectroscopy is a powerful tool for understanding gas/liquid transport phenomena in porous materials. By using a small perturbation of the voltage amplitude within a large range of frequencies, the method can exploit transport processes under steady-state conditions in grains, grain boundaries and interfaces. Based on a model in space charge relaxation of dielectric materials, the value of diffusion coefficients of charged carriers/molecules can be determined [2].

In this study, the molecular diffusion coefficient of isopropanol over H-ZSM5 (prepared by [3]) was characterized by impedance spectroscopy. The results are compared to literature data. The adsorption/diffusion mechanism of isopropanol in the zeolite inside the micropore structure as well as the electrical characterization and the activation energy are discussed. FTIR spectroscopy supports the characterization during isopropanol adsorption. Results will be shown in detail on the poster.

References

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